

AD 750133

AFFDL-TR-72-64

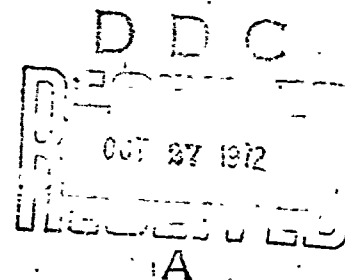
VOLUME II

DEVELOPMENT OF AN UNDERSTANDING OF THE FATIGUE PHENOMENA
OF BONDED AND BOLTED JOINTS
IN ADVANCED FILAMENTARY COMPOSITE MATERIALS
VOLUME II, FABRICATION, INSPECTION AND TESTING

A. C. Fehrie, G. J. Gilbert, E. C. Young, et al
LOCKHEED-GEORGIA COMPANY
MARIETTA, GEORGIA

TECHNICAL REPORT AFFDL-TR-72-64 , VOLUME II

June 1972



Approved for public release; distribution unlimited

Reproduction by
NATIONAL TECHNICAL
INFORMATION SERVICE
Springfield, Mass.
Ordering Plan No. 291-61

AIR FORCE FLIGHT DYNAMICS LABORATORY
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

X See Also AD 750132

328
✓

**Best
Available
Copy**

NOTICE

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

A

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Lockheed-Georgia Company A Division of Lockheed Aircraft Corporation Marietta, Georgia 30060		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE DEVELOPMENT OF AN UNDERSTANDING OF THE FATIGUE PHENOMENA OF BONDED AND BOLTED JOINTS IN ADVANCED FILAMENTARY COMPOSITE MATERIALS			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Technical Report August 1970 through April 1972			
5. AUTHOR(S) (First name, middle initial, last name) Albert C. Fehrle, Gerald J. Gilbert, and Edward C. Young, et al			
6. REPORT DATE June 1972		7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
8a. CONTRACT OR GRANT NO F33615-70-C-1302		9a. ORIGINATOR'S REPORT NUMBER(S) AFFDL-TR-72-64 -Vol II	
b. PROJECT NO 4364		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) ER-11319	
c.			
d.			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES Volume II, Fabrication, Inspection and Testing		12. SPONSORING MILITARY ACTIVITY Air Force Flight Dynamics Laboratory Air Force Systems Command Wright-Patterson AFB, Ohio	
13. ABSTRACT This is Volume II of a final report presented in three volumes; Vol I - Analysis Methods; Vol II - Fabrication, Inspection and Testing; Volume III - Fatigue Analysis and Failure Mode Studies. Fabrication and inspection methods were established which resulted in specimens of uniform high quality fabricated to close tolerances. Both bonded and bolted joints of widths from one to ten inches were evaluated. Primary emphasis was on joints in boron-epoxy, and between boron-epoxy and titanium or aluminum; however limited evaluations of graphite-epoxy/titanium and fiberglass-epoxy/titanium were included. Joint configuration evaluated were: single and double splice butt joints; boron-epoxy to metal stepped single scarf joints; and surface to understructure attachments. All laminates and specimens were inspected non-destructively. Base material properties and process control measures were verified by destructive testing. Developing testing techniques and actual specimen testing was a major portion of the program. Details of illustrations in this document may be better studied on microfiche			

DD FORM 1473
1 NOV 55

UNCLASSIFIED

Security Classification

UNCLASSIFIED

Security Classification

14

KEY WORDS

LINK A

LINK B

LINK C

ROLE

WT

ROLE

WT

ROLE

WT

bonded joints

mechanical joints

boron-epoxy

composite materials

Graphite-epoxy composite materials

fiberglass-epoxy composite materials

fatigue testing

fatigue endurance

fatigue analysis

photoelastic stress analysis

material properties

joint fabrication

non-destructive inspection

UNCLASSIFIED

Security Classification

DEVELOPMENT OF AN UNDERSTANDING OF THE FATIGUE PHENOMENA
OF BONDED AND BOLTED JOINTS
IN ADVANCED FILAMENTARY COMPOSITE MATERIALS
VOLUME II, FABRICATION, INSPECTION, AND TESTING

A. C. Fehrle, G. J. Gilbert, E. C. Young, et al
LOCKHEED-GEORGIA COMPANY
MARIETTA, GEORGIA

Approved for public release; distribution unlimited

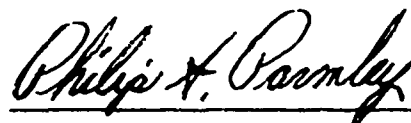
FOREWORD

This report summarizes the work accomplished under Contract F33615-70-C-1302, "Development of an Understanding of the Fatigue Phenomena of Bonded and Bolted Joints in Advanced Filamentary Composite Materials", Project Number 4364, and was prepared by the Lockheed-Georgia Company, a Division of Lockheed Aircraft Corporation. The work reported herein was sponsored by the Advanced Composite Branch, Air Force Flight Dynamics Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio 45433. Mr. Rodman Joblove, FBC, was the Air Force Project Engineer and Mr. A. C. Fehrle was the Lockheed-Georgia Program Manager.

The authors of Volume II are Dr. E. C. Young, Mr. A. R. Holland, Mr. W. P. Lanier, Mr. G. J. Gilbert, and Mr. A. C. Fehrle. Dr. E. C. Young was responsible for the fabrication of all specimens including laminate coupons, bonded joints and mechanical joints. Mr. A. R. Holland was responsible for basic material evaluation and Mr. W. P. Lanier was responsible for the non-destructive inspections of all test specimens. Mr. G. J. Gilbert and Mr. A. C. Fehrle were responsible for specimen testing and basic data evaluation.

This technical report has been reviewed and is approved.

For internal control purposes, this report has been assigned Lockheed-Georgia Company Report Number ER-11319.



Philip A. Parmley
Chief, Advanced Composite Branch
Structures Division
Air Force Flight Dynamics Laboratory

ABSTRACT

Fabrication and inspection methods were established which resulted in specimens of uniform high quality fabricated to close tolerances. Both bonded and bolted joints of widths from one to ten inches were evaluated. Primary emphasis was on joints in boron-epoxy, and between boron-epoxy and titanium or aluminum. However, limited evaluations of graphite-epoxy/titanium and fiberglass-epoxy/titanium were included. Joint configurations evaluated were single and double splice butt joints; boron-epoxy to metal stepped single scarf joints; and surface to understructure attachments. All laminates and specimens were inspected non-destructively. Base material properties and process control measures were verified by destructive testing. Developing testing techniques and actual specimen testing was a major portion of the program.

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
I	INTRODUCTION	1
II	FABRICATION	4
2.1	GENERAL	4
2.1.1	Introduction to Specimen Configurations	4
2.1.2	Citation of Detailed Specification Drawings	12
2.1.3	Citation of Program Test Plan and Specimen Identification Charts	12
2.1.4	Citation of Fabrication and Inspection Logs	12
2.1.5	Highlights of Lessons Learned in Fabrication	13
2.2	BASIC LAMINATE PANEL FABRICATION	14
2.3	JOINT FABRICATION - CONFIGURATION A, SINGLE SPLICE BUTT, BONDED	19
2.3.1	Phase II Fabrication - Configuration A	26
2.3.2	Phase III Fabrication - Configuration A	26
2.3.3	Alternate Adherend Evaluation - Configuration A Fiberglass Specimens	30
2.3.4	Alternate Adherend - Configuration A Graphite Specimens	31
2.4	JOINT FABRICATION - CONFIGURATION B, BORON-TO-METAL STEPPED SINGLE SCARF	32
2.4.1	Phase II Fabrication - Configuration B	35
2.4.2	Phase III Fabrication - Configuration B	36
2.5	JOINT FABRICATION - CONFIGURATION C, SURFACE TO UNDERSTRUCTURE ATTACHMENT, BONDED	41
2.6	JOINT FABRICATION - CONFIGURATION D, DOUBLE SPLICE BUTT, BONDED	46
2.7	JOINT FABRICATION - CONFIGURATION E, SINGLE SPLICE BUTT, BOLTED	47
2.7.1	Phase II Fabrication - Configuration E	55
2.8	JOINT FABRICATION - CONFIGURATION F, SURFACE TO UNDERSTRUCTURE - MECHANICAL	56

Preceding page blank

TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
III	TECHNICAL INSPECTION AND QUALITY ASSURANCE	59
3.1	INTRODUCTION	59
3.2	NONDESTRUCTIVE EVALUATION OF BONDED COMPOSITE JOINTS	59
3.2.1	Ultrasonic Inspections	60
3.2.2	Radiography Inspections	70
3.2.3	Microwaves Inspections	73
3.2.4	Visual Inspections: Bondline Measurement	75
3.2.5	NDE Data Analysis and Comparison	79
3.3	MATERIAL ACQUISITION AND ASSESSMENT	81
3.3.1	Acquisition of Tape Materials	82
3.3.2	Acceptance and Process Control Assessment	83
3.3.3	Material Properties Verification	88
IV	TEST PROGRAM	91
4.1	GENERAL	91
4.2	GENERAL TEST EQUIPMENT	102
4.2.1	Static Test Machines	102
4.2.2	Fatigue Test Machines	102
4.2.3	Programming Equipment	104
4.2.4	Instrumentation and Recording Equipment	106
4.3	GENERAL TEST REQUIREMENTS AND TEST METHOD APPROACH	106
4.4	MATERIAL VERIFICATION TESTS	108
4.4.1	Specimen Configuration	108
4.4.2	Test Procedure and Results	108
4.5	BONDED JOINT TESTS - CONFIGURATION A - SINGLE SPLICE BUTT JOINT	121
4.5.1	Specimen Configuration	121
4.5.2	Test Procedure and Results - Phase I	121
4.5.3	Test Procedures and Results - Phase II	133
4.5.4	Test Procedures and Results - Phase III	137

TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Title</u>	<u>Page</u>
IV (Continued)		
4.6	BONDED JOINT TESTS - CONFIGURATION B - STEP LAP SCARF JOINT	145
4.6.1	Specimen Configuration	145
4.6.2	Test Procedure and Results - Phase I and II	145
4.6.3	Test Procedure and Results - Phase III	151
4.7	BONDED JOINT TESTS - CONFIGURATION C - TEE SUPPORT JOINT	152
4.7.1	Specimen Configuration	152
4.7.2	Test Procedure and Results	152
4.8	CONFIGURATION D - DOUBLE STRAP JOINT TESTS	160
4.8.1	Specimen Configuration	160
4.8.2	Test Procedure and Results	160
4.9	BONDED JOINT - CUMULATIVE DAMAGE TESTS	163
4.9.1	Specimen Configuration	163
4.9.2	Test Procedure and Results	163
4.10	MECHANICAL JOINT TESTS - CONFIGURATION E - SINGLE SPLICE BUTT JOINT	166
4.10.1	Specimen Configuration	166
4.10.2	Test Procedure and Results	166
4.11	MECHANICAL JOINT TESTS - CONFIGURATION F - TEE JOINT	178
4.11.1	Specimen Configuration	178
4.11.2	Test Procedure and Results	178
4.12	MECHANICAL JOINT TESTS - CUMULATIVE DAMAGE	180
4.12.1	Specimen Configuration	180
4.12.2	Test Procedure and Results	180
4.13	SUMMARY	180
APPENDIX A	FA&RICATION AND INSPECTION LOGS	182
APPENDIX B	TEST DATA FORMS	235
APPENDIX C	JOINT DESIGNS	305

LIST OF ILLUSTRATIONS

<u>Figure</u>	<u>Title</u>	<u>Page</u>
1	Configuration "A" - Single Splice Butt Joint - Bonded	5 & 19
2	Configuration "B" - Boron to Metal Stepped Single Scarf Joint	6 & 32
3	Configuration "C" - Surface to Understructure Attachment - Bonded	7 & 41
4	Configuration "D" - Double Splice Butt Joint - Bonded	8 & 46
5	Configuration "E" - Single Splice Butt Joint - Bolted	9 & 47
6	Configuration "F" - Surface to Understructure Attachment - Mechanical	10 & 56
7	Step Chart for Basic Laminate Fabrication	14
8	Step Chart for Configuration "A" Specimens (Also for "D")	20
9	Alignment Fixture for Holding Specimens for Splice and Tab Bond	22
10	Layup of Three 12" X 18" Bonded Panel Assemblies	24
11	Three Inch Wide Configuration A Specimen	28
12	Phase III Configuration A - Single Splice Butt Joint	29
13	Step Chart for Configuration "B" Specimens	33
14	Bonded Panel Assembly - Configuration "B" Specimens	37
15	Machined Configuration "B" Specimens	38
16	Phase II Configuration "B" - Step Scarf Bonded Joint	39
17	Phase III Configuration "B" - Step Scarf Bonded Joint	40
18	Step Chart for Configuration "C" Specimens	42
19	Three Configuration "C" Specimens	45
20	Edge View of Configuration "C" Specimens	45
21	Step Chart for Configuration "E" Specimens	48
22	Configuration "E" Specimen Details	52
23	Configuration "E" Completed Specimens	53
24	Configuration "E" Joint Close Up	53
25	Configuration "E" Mechanical Joints	54
26	Step Chart for Configuration "F" Specimens	57

LIST OF ILLUSTRATIONS (Continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
27	Typical C-Scan Recording	61
28	Ultrasonic C-Scan Inspection System	62
29	Pulse-echo Technique	63
30	Ultrasonic Signal Presentation on Cathode Ray Tube	65
31	C-Scan Recording of Typical Joint Specimen	66
32	C-Scan Recording of Poorly Bonded Joint	67
33	C-Scan Recordings from Graphite and Fiberglass Composite Joints	68
34	X-Ray Source	71
35	Defect Conditions in Filamentary Composites	72
36	Microwave System	74
37	Micropositioner and Specimen	76
38	Joint Specimens Showing Bondlines	77
39	Bondline Measuring System	78
40	Comparison of Fatigue Data for Material Verification	90
41	Resonant Frequency Fatigue Machine	103
42	MTS Machine - 30,000 Pound Capacity	105
43	MTS Machine - 100,000 Pound Capacity	105
44	Extensometer with Strain Gages	107
45	Static and Axial-Load Fatigue Test Specimen Configuration	109
46	Axial-Load, Negative Stress Ratio Fatigue Test Specimen Configuration	110
47	Stress-Strain Relationship Tensile Coupon $0^\circ/\pm 45^\circ$	111
48	Stress-Strain Relationship Tensile Coupon $0^\circ/90^\circ$	112
49	Typical Failure Axial Fatigue, $R = +0.10$	114
50	Typical Failure Axial Fatigue, $R = -1.0$	114
51	Material Verification Fatigue Test	115
52	Support System for Configuration A Joints	117
53	Test Specimens with Support Plates	118
54	Typical Static Failure Surface Titanium to Titanium	119

LIST OF ILLUSTRATIONS (Continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
55	Typical Fatigue Failure Surface Titanium to Titanium	119
56	S-N Curve for Single Splice Butt Joint Configuration "A" - Epon 9601 Adhesive	120
57	Modified Support Fixture	122
58	Static Tensile Test with Extensometer	122
59	Side View of Modified Support Plate	123
60	Front View of Modified Support Plate	123
61	Configuration A, Boron/Titanium Baseline Specimen R = +0.1	124
62	Configuration A, Boron/Titanium Baseline Specimen R = -1.0	124
63	Configuration A, Boron/Titanium Baseline Specimen R = +10.0	125
64	Configuration A Boron/Titanium Ply Stacking Specimen	127
65	Configuration A, Boron/Boron Ply Stacking Specimen	127
66	Joint Stiffness - Static Tensile Tests	128
67	Joint Stiffness - After Fatigue Cycling, R = +0.1	129
68	Joint Stiffness - Static Compression Tests	130
69	Joint Stiffness - After Fatigue Cycling, R = +10.0	131
70	Configuration A - Three Inches Wide Boron/Titanium Baseline Specimens	134
71	Configuration A - Three Inches Wide Boron/Titanium, Long Lap Length	135
72	Configuration A - Three Inches Wide Boron/Aluminum Baseline Specimen	136
73	End Fitting For Phase III - 10.0-Inch Wide Specimen	138
74	Test Setup for Ten-Inch Wide Configuration A Specimen	139
75	Control Specimen for Boron/Aluminum Configuration A 10-inch Wide Specimen	140
76	Control Specimen for Boron/Titanium Configuration A 10-inch Wide Specimen	140
77	Configuration A - Ten Inches Wide Boron/Titanium R = +0.1	141
78	Configuration A - Ten Inches Wide Boron/Aluminum R = +0.1	142
79	Configuration A - Ten Inches Wide Boron/Titanium R = -1.0	143

LIST OF ILLUSTRATIONS (Continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
80	Configuration A - Ten Inches Wide Boron/Aluminum R = -1.0	144
81	Support Plate System for Configuration B Joint Specimen	146
82	Configuration B, Boron/Aluminum Baseline Specimen	147
83	Configuration B, Boron/Titanium Baseline Specimen	147
84	Configuration B, Boron/Titanium Baseline Specimen	148
85	Configuration B, Boron/Titanium Short Lap Length	148
86	Configuration B, Three Inches Wide Boron/Aluminum Step Lap Scarf Joint	149
87	Configuration B, Three Inches Wide Short Overlap Boron/Titanium, Step Lap Scarf Joint	150
88	Test Fixture for Configuration C and Configuration F Specimens	153
89	Test Fixture for Configuration C Bonded Tee Joint and Test Equipment	155
90	Test Set-Up for Configuration C Specimen	156
91	Configuration C Specimen Under Fatigue Loading Just Prior to Failure	157
92	Configuration C, Titanium Tee/Boron Static Test	158
93	Configuration C, Titanium Tee/Boron Fatigue Failure, R = +0.1	158
94	Configuration C, Titanium Tee/Boron Fatigue Failure, R = +0.1	159
95	Configuration D, Boron/Titanium, Static Test, Titanium Splice Plates	161
96	Configuration D, Boron/Titanium, Fatigue Test R = +0.1, Titanium Splice Plates	161
97	Configuration D, Titanium/Boron Static and Fatigue Boron Splice Plates	162
98	Typical Strip-Chart Recording of Individual Load Levels in Each Mission - Realistic Load Spectrum	165
99	Close-up of Pin Bearing Set-Up	167
100	Pin Bearing Specimen e/D = 2.0 Titanium Reinforced	168
101	Pin Bearing Specimen e/D = 1.5 Titanium Reinforced	168
102	Pin Bearing Specimen e/D = 2.0 $\pm 45^\circ$ Boron Reinforced	170
103	Mechanical Joints With Support Plates	170

LIST OF ILLUSTRATIONS (Continued)

<u>Figure</u>	<u>Title</u>	<u>Page</u>
104	Test Set-up For Monitoring Fastener Rotation	171
105	Set-Up for Maintaining Specimen Temperature	171
106	Configuration E, Baseline ($0^\circ/\pm 45^\circ$) Boron/Titanium	172
107	Configuration E, Baseline $R = -1.0$ ($0^\circ/\pm 45^\circ$) Boron/Titanium	173
108	Configuration E, Baseline $R = -0.1$ Boron/Boron ($0^\circ/\pm 45^\circ$ With Titanium Shims)	173
109	Configuration E, Thickness Effects Titanium/Boron Reinforced With $\pm 45^\circ$ Boron Typical Failure @ $R = +0.1$	174
110	Configuration E, Thickness Effects Titanium/Boron Reinforced With Titanium Typical Splice Plate Failure	174
111	Configuration E, Short Edge Distance Boron/Titanium, Titanium Shims in Boron	175
112	Configuration E, Two Inches Wide, Baseline Typical Static Tensile Failure	176
113	Configuration E, Two Inches Wide, Baseline Typical $R = +0.1$	176
114	Configuration F Baseline Static Tests	179

LIST OF TABLES

<u>Table</u>	<u>Title</u>	<u>Page</u>
I	Specimen Widths	4
II	Boron-Epoxy Acceptance and Control Panel Identification	84
III	Boron-Epoxy Acceptance and Quality Control Data	85
IV	Results of Control Testing for Graphite-Epoxy and Glass-Epoxy Laminates	89
V	Alternate Adherend Materials Evaluation	92
VI	Material Verification and Checkout Tests	93
VII	Bonded Joints Evaluation - Phase I	94
VIII	Bonded Joints Evaluation - Phase II	96
IX	Bonded Joints Evaluation - Phase III	98
X	Mechanical Joints Evaluation	100
XI	Truncated Block Spectrum Loadings	181

SECTION I

INTRODUCTION

This program was undertaken to develop an understanding of the fatigue phenomena of structural joints in advanced filamentary composite materials and to develop analytical and testing methods to support proper fatigue design of advanced composite structural joints. The program included the evaluation of both bonded and bolted joints. Primary emphasis was placed on joints in boron-epoxy; however, a limited evaluation of bonded joints in graphite-epoxy and glass-epoxy were included. Although the sizes of the joints for this investigation were small (one to ten inches in width), all configurations evaluated are representative of typical structural joints currently utilized in advanced filamentary composite structures.

The program consisted of three major areas of investigation:

- o Analysis Methods
- o Fabrication, Inspection and Testing
- o Fatigue Analysis and Failure Mode Studies

Analytical methods for determining joint stresses were divided into two major tasks, (1) analysis of bonded joints and (2) analysis of bolted joints. Primary emphasis was placed on the development of a closed form elastic analysis procedure for bonded joints. This analysis was used to evaluate a number of joint variables. A "plastic zone" approach was used to extend the closed form analysis procedure to include joints with inelastic adhesive stress-strain behavior. The results of the elastic closed form solution were verified with finite element analyses, photoelastic analysis and strain gage data. Finite element analyses were used to evaluate the step lap bonded joints and bolted joints.

The experimental program consisted of fabrication, inspection and testing of a large quantity of joint specimens. Fabrication and inspection methods were established which resulted in specimens being fabricated to close tolerances and of uniform high quality. This provided specimens that would consistently develop stresses that were predicted by the analytical methods. Developing testing techniques and actual specimen testing was a major portion of the program. Establishing proper specimen support was essential to

obtaining repeatable joint strengths within a specimen configuration. Equally important was determining the proper cyclic rate for the different stress ratios and specimen configurations to preclude specimen heating and erratic fatigue lives.

Evaluation of the experimental results was divided into two separate but related tasks. These tasks were failure mode studies and fatigue analyses. The failure mode studies mentioned were photomicrographic analyses of the failure surfaces. This failure mode analysis does not replace but augments the gross failure modes generally defined within the experimental phases of a program. The photomicrographic analysis conducted within this program established failure modes related to specific joint designs, joint loading and fatigue history. The fatigue analysis established relationships between specimen configuration, joint variables, material combinations, loading conditions and stress ratio effects for constant amplitude loading. The relationship between constant amplitude fatigue and spectrum fatigue (block and realistic) was also evaluated for specific joint configurations.

This report is divided into three separate volumes each containing the developments accomplished within a major area of investigation. Each volume is a self-contained document, complementing the other two volumes but not dependent upon them for coherence or continuity. The titles of the three volumes are:

Volume I - Analysis Methods

Volume II - Fabrication, Inspection and Testing

Volume III - Fatigue Analysis and Failure Mode Studies

Volume II is divided into three sections: Fabrication, Technical Inspection and Quality Assurance, and Test Program. The Fabrication section contains details related to laminate fabrication using boron-epoxy, graphite-epoxy, and fiberglass-epoxy. Methods for joining the various bonded and mechanical joints is also discussed in detail. The Technical and Quality Assurance section contains information related to nondestructive inspection of all laminates and specimens, destructive test verification of the base materials, and process control requirements for all specimens fabricated. The Test Program section identifies all test, instrumentation, and programming equipment used during the entire

program. Also discussed are the general and specific test requirements for the different joint configurations. Test procedures and test results are included for all specimen configurations and program phases.

Included in the Appendices of this Volume are the Fabrication and Inspection Logs, Test Data Forms, and Joint Designs.

SECTION II FABRICATION

2.1 GENERAL

2.1.1 Introduction to Specimen Configurations

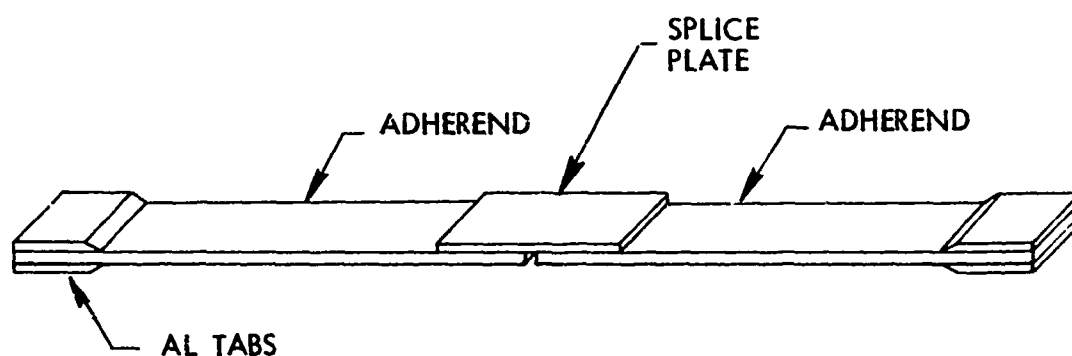
This section describes in summary fashion the types of specimens that were fabricated and provides an overview of the fabrication program. Location of precisely detailed specifications and data for individual specimens as cited in Sections 2.1.2, 2.1.3, and 2.1.4. Details of fabrication procedures are presented in Section 2.2 through Section 2.8. Specimens fabricated for this program are illustrated in Figures 1 through 6 and are listed below:

Configuration "A":	Single Splice Butt Joint - Bonded
Configuration "B":	Boron to Metal Stepped Single Scarf Joint
Configuration "C":	Surface to Understructure Attachment (Titanium tee) - Bonded
Configuration "D":	Double Splice Butt Joint - Bonded
Configuration "E":	Single Splice Butt Joint - Bolted
Configuration "F":	Surface to Understructure Attachment (aluminum tee) - Mechanical

All Phase I specimens were 1" wide as illustrated in Figures 1 through 6. These 1" wide specimens constituted the major portion of the program. Intermediate width specimens (2" or 3" wide) were investigated in Phase II, and large scale joints were investigated in Phase III, as indicated below:

TABLE I - SPECIMEN WIDTHS

<u>Configuration</u>	<u>Phase I</u>	<u>Phase II</u>	<u>Phase III</u>
"A"	1"	3"	10"
"B"	1"	3"	10"
"C"	1"	--	--
"D"	1"	--	--
"E"	1"	2"	--
"F"	1"	--	--



Size: Approx. 18" X 1" width (Phase I, illustrated)

ADHEREND/SPLICE PLATE/ADHEREND

Boron/Titanium/Boron

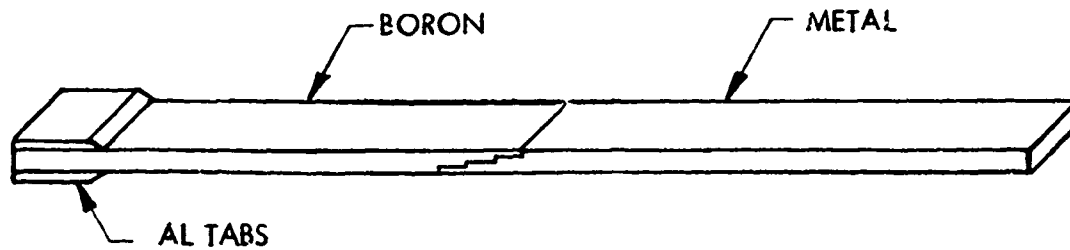
Boron/Boron/Boron

Boron/Aluminum/Boron

Graphite/Titanium/Graphite

Glass/Titanium/Glass

FIGURE 1 - CONFIGURATION "A" SINGLE SPLICE
BUTT JOINT - BONDED



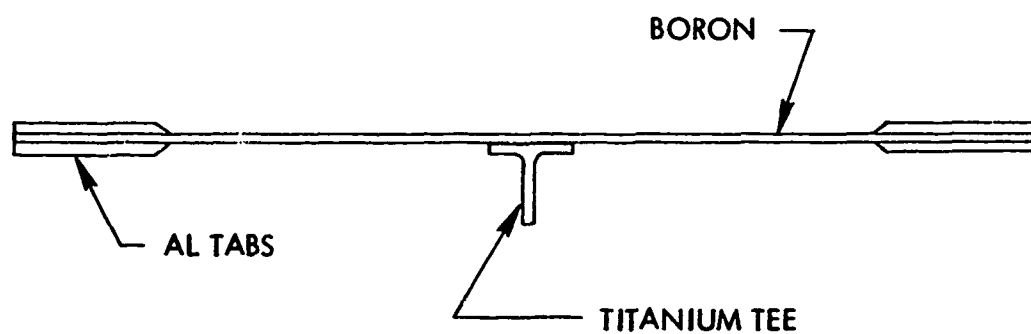
Size: Approx. 18" X 1" width (Phase I, illustrated)

BORON/METAL

Boron/Titanium

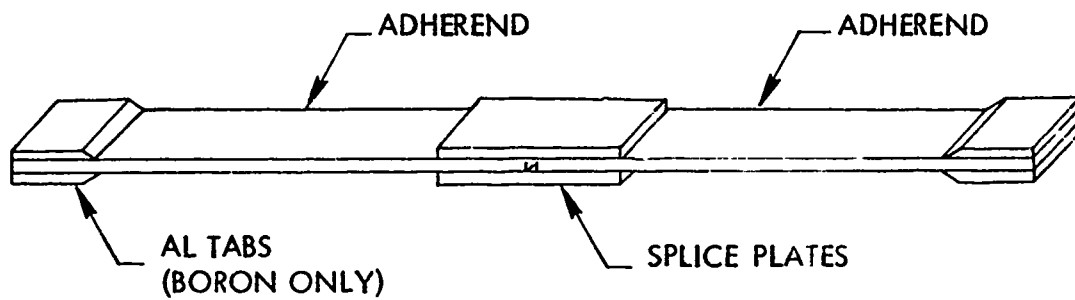
Boron/Aluminum

FIGURE 2 - CONFIGURATION "B" BORON TO METAL STEPPED SINGLE SCARF JOINT



Size: 18" X 1"

FIGURE 3 - CONFIGURATION "C" SURFACE TO UNDERSTRUCTURE
ATTACHMENT-BONDED



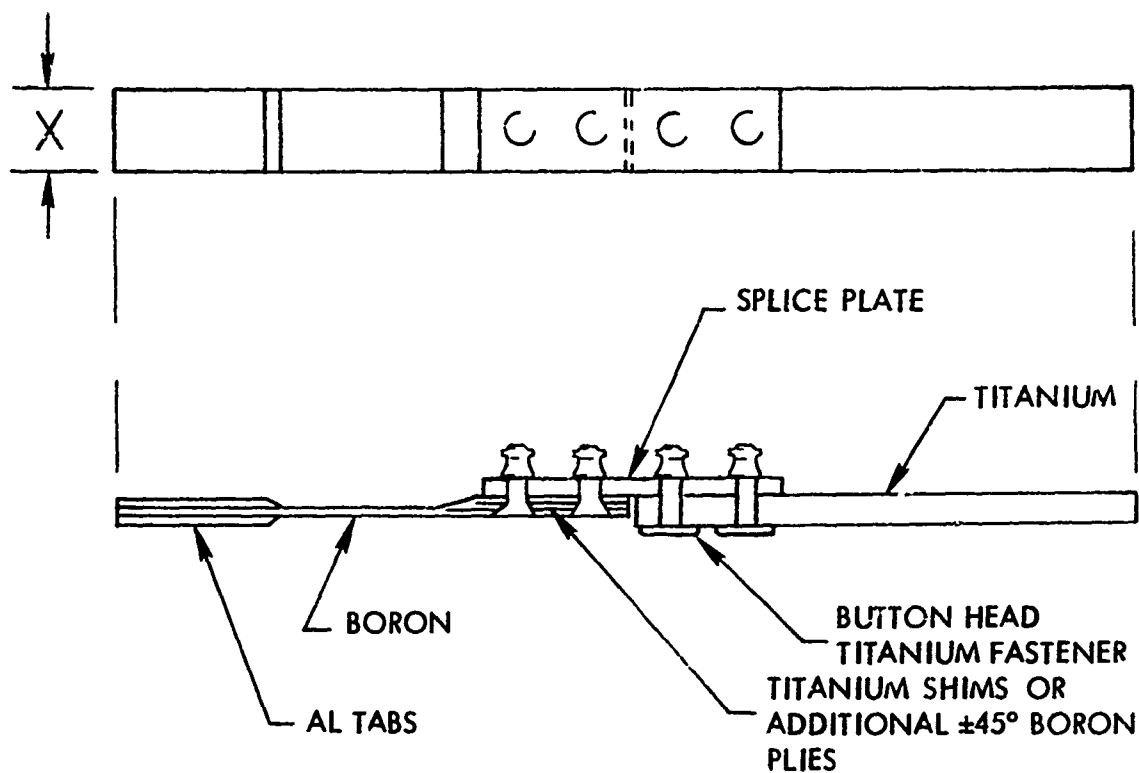
Size: Approx. 18" X 1"

ADHEREND/SPLICE PLATES/ADHEREND

Boron/Titanium/Boron

Titanium/Boron/Titanium

FIGURE 4 - CONFIGURATION "D" DOUBLE SPLICE BUTT JOINT - BONDED



Size: Approx. 18" X 1" width (Phase I, illustrated)

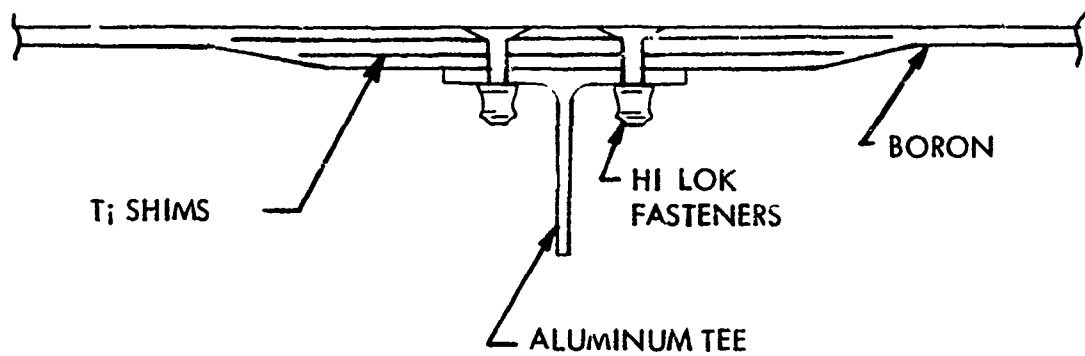
ADHEREND/SPLICE/ADHEREND

Boron + Ti shim buildup/Boron + Ti shim/Titanium

Boron + Ti shim buildup/Titanium/Titanium

Boron + Boron ± 45° buildup/Titanium/Titanium

FIGURE 5 - CONFIGURATION "E" SINGLE SPLICE BUTT JOINT - BOLTED



Size: 18" X 1" width

FIGURE 6 - CONFIGURATION "F" SURFACE TO UNDERSTRUCTURE
ATTACHMENT - MECHANICAL

Approximately 75% of the specimens represented bonded joints; the remainder represented mechanical joints.

Material combinations across joints are listed in the appropriate figure. All bonded joints were bonded with Hysol EA 9601 adhesive previously designated Shell EPON 9601, except for some 1A specimens which were used to evaluate a second adhesive, Narmco Metlbond 329. Where splice plates were used, the material of the splice plate is the second member of the triplet. For increased bearing strength, titanium shims (.012" thick Ti-6Al-4V annealed) or additional boron plies ($\pm 45^\circ$ orientation) were interleaved between boron plies of the basic laminates in the mechanical joint specimens.

"Boron", as used in Figure 1 and elsewhere, refers to boron-epoxy laminate fabricated from Narmco 5505 boron-epoxy prepreg 3" wide tape with glass fabric carrier. This prepreg contains nominal 0.004 inch diameter filaments collimated to 212 ± 4 filaments per inch. The matrix resin is a 350°F curing epoxy. Laminates cure to nominal 0.0054 inches per ply and contain approximately 50 volume percent boron filament in the cured condition. Ply orientations of $0^\circ/\pm 45^\circ$ or $0^\circ/90^\circ$ were used for bonded specimens. All bolted specimens used laminates of ply orientation $0^\circ \pm 45^\circ$, except for some unidirectional laminate specimens used for the Baseline Data Task.

The titanium alloy used throughout this program, including bearing reinforcement shims, was all Ti-6Al-4V alloy with two exceptions. The extruded titanium tees for Configuration "C" was Ti-6Al-6V-2Sn alloy. The titanium splice plates and load plates of the Configuration "E" specimens was Ti-8Al-1Mo-1V alloy.

The aluminum splice plates (Configuration "A") and aluminum adherends (Configuration "B") were aluminum alloy 7075-T6. Extruded aluminum tees (Configuration "F") were also 7075 alloy.

Fiberglass and graphite laminates were fabricated and used for Configuration "A" specimens in the Alternate Adherend Evaluation Task. The fiberglass laminate was fabricated using 3M 1002 S glass prepreg tape. The same ply orientation, $0^\circ \pm 45^\circ$, was used as for the baseline boron specimens.

Graphite laminates were fabricated using Fiberite Hy E 131 1B graphite/epoxy tape. Graphite laminates were also balanced 8-ply $0^\circ \pm 45^\circ$ orientations.

2.1.2 Citation of Detailed Specification Drawings

Detailed dimensions, tolerances, and references to materials and process standards are presented in the Drawings No. 7226-13021A through 7226-13021F which appear in Appendix C.

2.1.3 Citation of Program Test Plan and Specimen Identification Charts

Tables V through X of Section 4.1, TEST PROCEDURES - GENERAL, list the quantities of specimens fabricated and tested for each major Configuration ("A", "B", "C", etc.).

These tables also provide a breakdown of the specimen quantities per Phase (width) and Program Task (Baseline Data, Thickness Effects, etc.), as well as materials combinations (Adherend Combinations for bonded joints or Joint Elements for mechanically fastened joints) and variations in subconfigurations (ply orientations, titanium shims versus added boron plies, etc.).

A guide to the specimen identification system is also presented in Section 4.1.

2.1.4 Citation of Fabrication and Inspection Logs

Fabrication and inspection details for all laminate panels and joint specimens are summarized in the log sheets of Appendix A.

2.1.5

Highlights of Lessons Learned in Fabrication

Fiberglass peel plies, Narmco 1581/2054, were used to prepare the adhesive bonding surfaces on boron laminates panels for Configuration "A", "C", "D" bonded joint specimens. Early attempts to sand the bonding surfaces, in an attempt to obtain more uniform bondline thicknesses, caused wide variations in bond joint strength. The more reliable peel ply surface preparation resulted in bondline thicknesses generally in the range 0.004 to 0.006 inch.

A floating 0.020 inch Teflon gap spacer plate was used to control the gap at the butt joint in Configuration "A" specimens. See Figure 9, item 7.

Chemical milling of the steps in the metallic adherends for the Configuration "B" scarf joint was required because of warpage encountered when mechanical milling was used.

Holes for fasteners were drilled in boron/boron assemblies using a diamond core drill. For boron/titanium assemblies an end mill was used for the titanium plate. Good back-up of boron laminates was required to prevent breakout on the back side of the hole. Holes in boron laminates were countersunk using a diamond tool.

Hi-Lok fasteners were wet installed and torqued to 30 ± 1 inch-pounds. After 30 minutes fasteners were re-torqued to the same load to account for any relaxation due to squeeze-out of sealant from the faying surfaces.

2.2 BASIC LAMINATE PANEL FABRICATION

All panels from which material verification and acceptance specimens, basic program joint test specimens, and quality control coupons were constructed, were fabricated in essentially the same manner except for the Configuration B step-lap joint specimens. For these specimens, the laminate and joint fabrication was accomplished by the co-curing process.

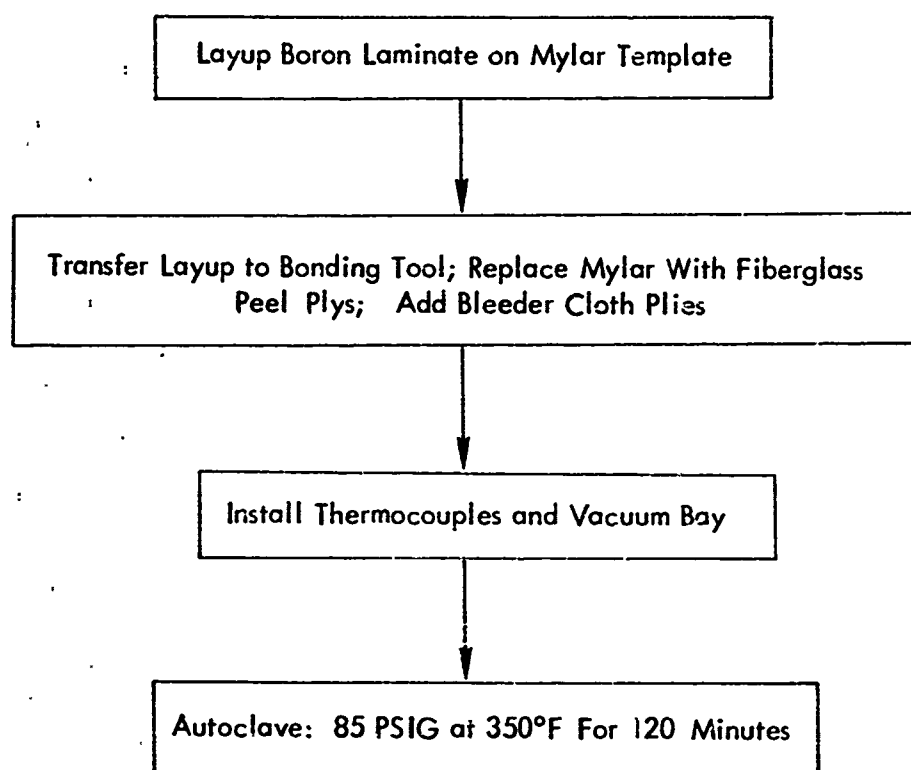


FIGURE 7 - STEP CHART FOR BASIC LAMINATE FABRICATION

The boron/epoxy laminates were fabricated using the following steps and procedures:

1. A template is prepared using 0.005" thick Mylar film. The panel dimensions are established by the number of specimens required from each panel. Panels are made slightly oversize to allow for panel trim and specimen machining. The largest panel fabricated was 36" X 56". Ninety-nine specimens one inch wide were cut from this panel.
2. The boron laminate is laid up using Narmco boron/5505 tape in accordance with the orientation and ply stacking for the given configuration. On the first ply, the scrim side of the tape is placed against the Mylar template. The final ply lay-up on the laminate is a layer of Narmco 104/2054 scrim.
 - a. The tape is visually inspected during lay-up to assure that the procedure has been carried out within the laminate specifications, i.e., 0.030" maximum gap, no overlapping of plies, no crossed filaments, etc.
 - b. Quality control specimens (used for determining the mechanical properties of the tape used in the lay-up) include a 15-ply, 3" X 6" flexural test coupon panel and a 6" X 9" cross-ply laminate ($0^\circ/\pm 45^\circ$ or $0^\circ/90^\circ$) for tensile testing as an optional control specimen.
3. The bonding tool is prepared by placing, on the tool surface, a sheet of Mylar the same size as the panel and covering it with Teflon-coated, 108 glass cloth.
4. The Mylar template is removed from the laminate and a fiberglass peel ply, Narmco 1581/2054, is applied to each surface of the laminate. The laminate is placed on the tool surface over the Mylar and Teflon coated glass cloth.

NOTE: The application of the peel plies is omitted for panels which are not to be used for subsequent joint fabrication.

5. Dams are prepared by shearing aluminum strips 1" wide, and covering them with Teflon masking tape, these are then located adjacent to the laminate, and taped to the tool surface.
 - a. Dam thickness is calculated by multiplying the number of boron plies by 5.25 mils/ply, adding 0.008" for each peel ply, 0.003" for the Mylar, 0.003" for the Teflon coated glass, and 0.004" for each ply of 116 glass cloth used in the bleeder.
6. The resin bleeder system is placed over the laminate.
 - a. One ply of Teflon coated 108 glass cloth is trimmed net to the inside of the dam, and placed over the laminate.
 - b. The required layers of 116 glass cloth bleeder are trimmed to the inside of the dam and placed over the Teflon coated glass cloth. One ply of bleeder cloth is used for each 10 plies of laminate. One ply of bleeder is added for each two plies of peel ply prepreg used.
 - c. The bleeder system is covered with 0.003" Mylar (cut net to middle of the dam). This cover is taped to the top of the dam and slit on approximately 20" centers with 1/8" long slits as a minimum, one slit is made at each corner of the panel.
7. The quality control specimens are located adjacent to the laminate on the tool, using the damming and bleeding procedure outlined in Steps 5 and 6, above.
8. Four thermocouples are on the installed tool adjacent to the dam and evenly spaced around the panel or panels.
9. The assembly is covered with two layers of 181 glass cloth. A chain is used to surround the assembly and provide air passage from the lay-up to the tool exhaust port. Extra 181 glass cloth is placed over the chain to

protect the bag during the curing cycle. The 181 glass cloth is then taped to the tool using high temperature masking tape.

10. High temperature, vacuum bag sealer compound tape is installed around the tool periphery outside the 181 glass cloth. Care is taken to be certain that no loose glass fibers are on or under the tape.

NOTE: The thermocouple wires are stripped of insulation, separated and placed on the sealer tape; additional sealer tape is placed over the wires and pressed to assure no leakage around the wires. Care is taken to be sure that the bared wires are not grounded against the tool surface.

11. The backing paper from the sealer compound tape is removed and the whole lay-up is covered with 0.002" nylon vacuum bag film for 375°F autoclave service.
12. Vacuum is applied to the tool vacuum port and the sealed bag is checked for leaks. The tool with the laminate assembly is installed in autoclave and rechecked for leaks.
13. Autoclave pressure is applied to 10 psig, and the vacuum is released. Autoclave pressure is held at 10 psig for 10 minutes to allow the bag to stabilize at atmospheric pressure, and is then increased to 85 psig.
14. The heating cycle was initially set at heat-up rate of 7°F/minute $\pm 2^\circ\text{F}/\text{minute}$. However, the Narmco 5505 resin system appeared to be sensitive to heat-up rate in that the faster heat-up rates yielded more consistent and slightly higher laminate properties in terms of horizontal shear and transverse flexure. For this reason, the upper limit of 7°F to 9°F/minute has been used for the most recent laminates in this study. No noticeable change in laminate tensile or bond strengths were observed.

15. The autoclave cycle is maintained at 85 psig ± 5 psig and 350°F ± 10 °F for 120 minutes.
16. After 120 minutes at curing temperature the part is allowed to cool to less than 150°F while holding the pressure at 85 psig. The pressure is then released and the autoclave opened.
17. The part is removed from the autoclave, removed from the tool, and cleaned up. The peel ply is not removed from the boron panel until just prior to bonding tabs and splice plates.
18. The quality control specimens are prepared for testing. The 15 ply 0° laminate is cut into 0.50" X 4.0" specimens for longitudinal flexural testing, 3.0" x 0.50" for transverse flexural testing and 0.50" x 0.60" for horizontal shear. The 8-ply cross-ply laminate is fitted with 1.50" long fiberglass tabs of 0.080" thickness with the inboard ends beveled to 45° and tabs are bonded with FM123-2, 0.060 lb./ft.² weight adhesive at 250°F and 20" vacuum. The 6" X 9" tabbed panel is then cut into 1" X 9" specimens using a diamond saw and specimens are ready for testing.

2.3 JOINT FABRICATION - CONFIGURATION A, SINGLE SPLICE BUTT, BONDED

Laminates fabricated by the procedures outlined in Section 2.2 were used for the basic adherends in the fabrication of the Configuration A specimens. These specimens are illustrated in Figure 1, which is repeated below. Individual specimens were fabricated according to the requirements of Dwg. No. 7226-130 1A, Appendix C.

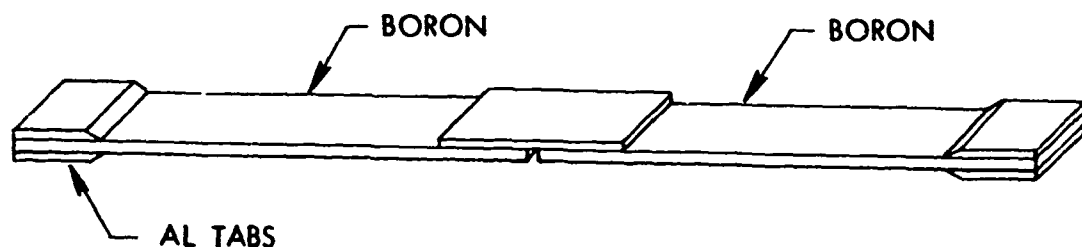


FIGURE 1 (REPEATED) - CONFIGURATION "A"
SINGLE SPLICE BUTT JOINT - BONDED

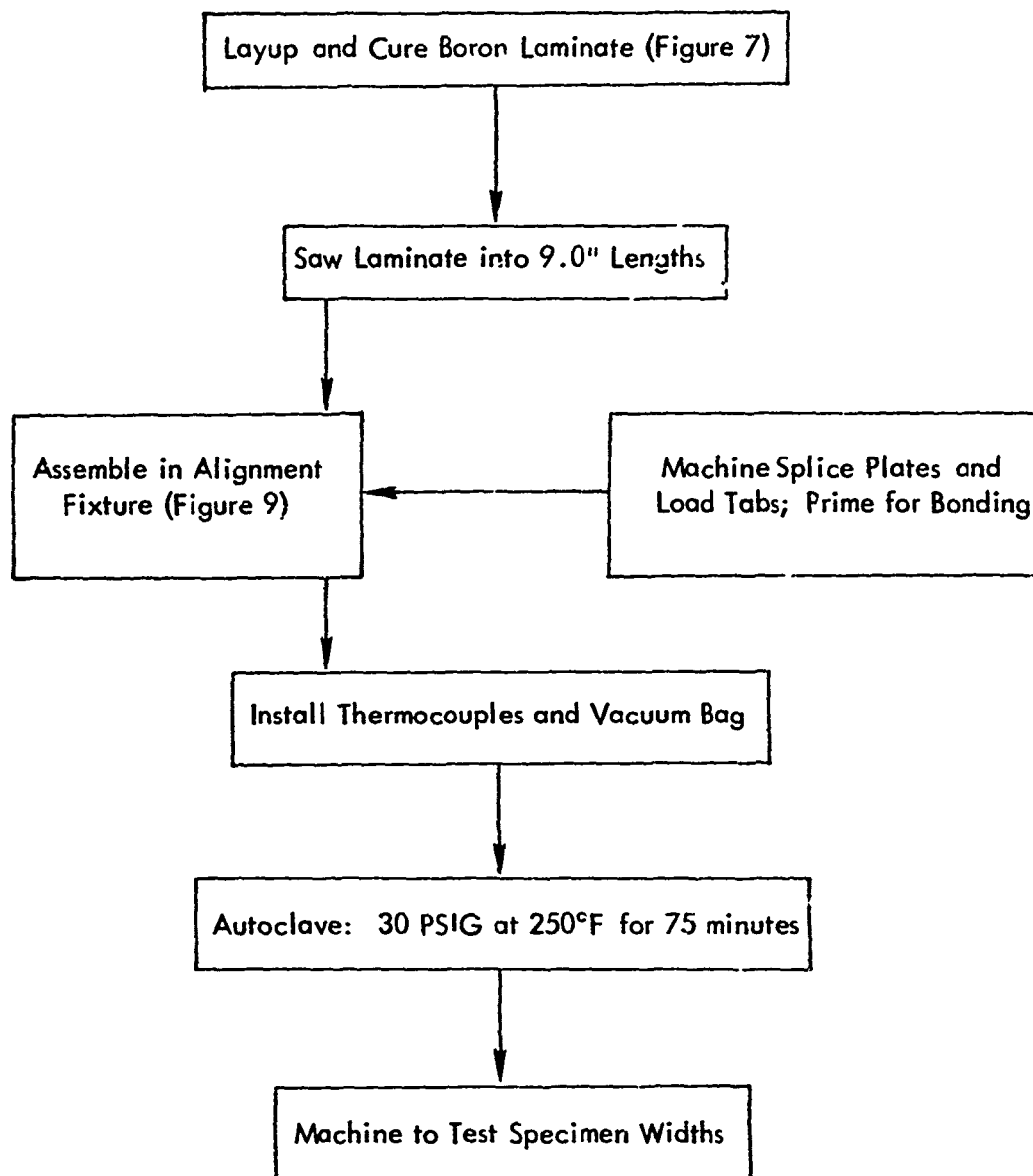
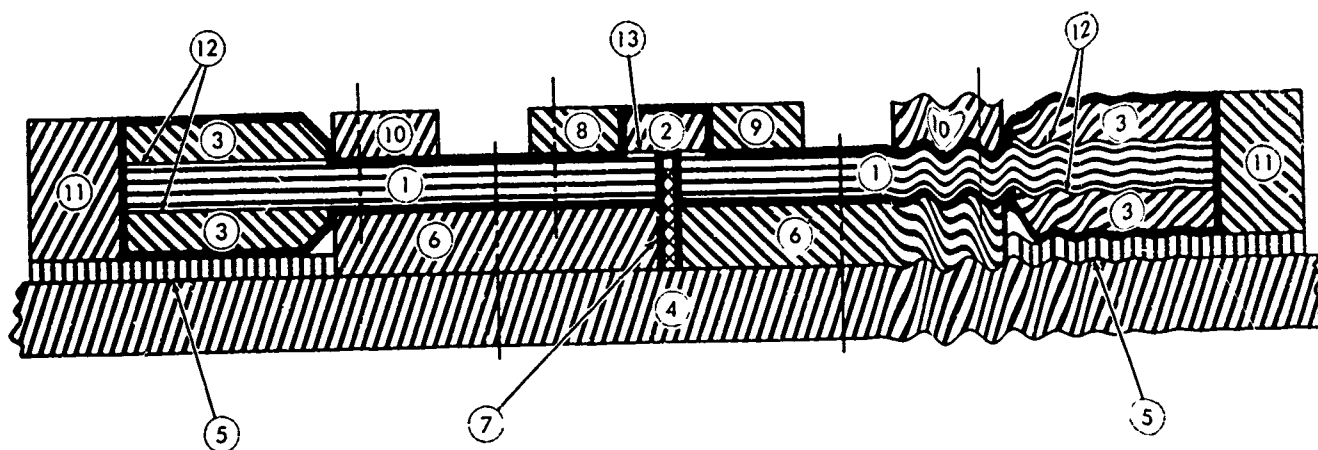


FIGURE 8 - STEP CHART FOR CONFIGURATION "A" SPECIMENS
(ALSO FOR "D")

The following steps and procedures were taken to assure acceptable quality and uniformity of specimen fabrication:

1. The basic laminate is machined into 9.0" lengths (0° direction) using a diamond circular table saw normally employed for machining fiber-glass panels in production. Panel widths varied from approximately 9" wide to 18" wide depending on the number of specimens to be obtained from each panel.
2. The splice plate material, either 6AL-4V annealed titanium or 7075-T6 aluminum, is machined to the thicknesses and configuration as specified on Dwg. No. 7226-13021A, Appendix C. Lengths are dictated by the panel width.
3. The load tabs are machined to the dimensions specified on Dwg. No. 7226-13021A from 2024-T3 aluminum. The tab "blanks" have lengths equal to the basic laminate width. Test panels (fabricated using fiber-glass tabs) were tested to compare results for the aluminum tabs and to verify the use of aluminum tabs in the program. Figure 9 is a schematic of the alignment fixture which holds the specimens during splice and tab bonding. In Steps 4 through 8, below, reference is made to this schematic, by parenthetical number - (X), to facilitate visualization of the layup sequence.
4. The base plate (4) is placed on the metal bond fixture and the centering plates (6) are positioned on the locating pins, with the floating Teflon gap spacer plate (7) placed at the butt ends of the centering plates.



CODE

- 1 - BORON LAMINATE ADHEREND
- 2 - SPLICE PLATE
- 3 - ALUMINUM TAB
- 4 - BASE PLATE
- 5 - SHIMS
- 6 - CENTERING PLATES
- 7 - 0.020 GAP SPACER - FLOATING
- 8 - FIXED SPLICE PLATE LOCATOR
- 9 - FLOATING SPLICE PLATE LOCATOR
- 10 - TAB LOCATOR
- 11 - DAM
- 12 - TAB ADHESIVE
- 13 - SPLICE ADHESIVE

FIGURE 9 - ALIGNMENT FIXTURE FOR HOLDING SPECIMENS
FOR SPLICE AND TAB BOND

5. The lower aluminum tabs (3) are butted against the centering plates with shims (5) placed under the tabs to level the tabs with the top of the centering plates. The tabs are cleaned, metal bond etched and primed for bonding prior to installation (clean glove operation). The AF123-2, 0.06 lb/ft² wt. adhesive (12) is laid on the faying surface of the tabs.
6. The laminates (1) with the peel plies removed* (clean glove operation) and the matching machined ends are positioned on top of the tabs and centering plates. Dams (11) are installed at the outboard ends of the laminates adherend and held in position with locating pins.

*NOTE: The original group of specimens was prepared by sanding the bonding surfaces rather than using peel ply surfaces in attempt to obtain more uniform bondline thickness. This caused a wide variation in bond joint strength and was replaced with the more reliable peel ply surface preparation.

7. The upper aluminum tabs (3) are then prepared for bonding and the adhesive applied. They are placed in position butting the dam and the tab locators (10) are then positioned on the opposite ends of the tab and pinned in place.
8. The splice plate (2) is chemically prepared for bonding, primed, and adhesive (13), EA9601 0.06 lb./ft² wt., applied to the faying surface. The fixed splice plate locator (8) is pinned in place and the splice plate butted against it. The floating splice plate locator (9) is positioned on the opposite end of the splice plate.
9. Thermocouples are installed on the base plate adjacent to the part. Figure 10 shows a layup of three 12" X 18" bonded panel assemblies after installation of thermocouples just prior to initiating the bagging operation.

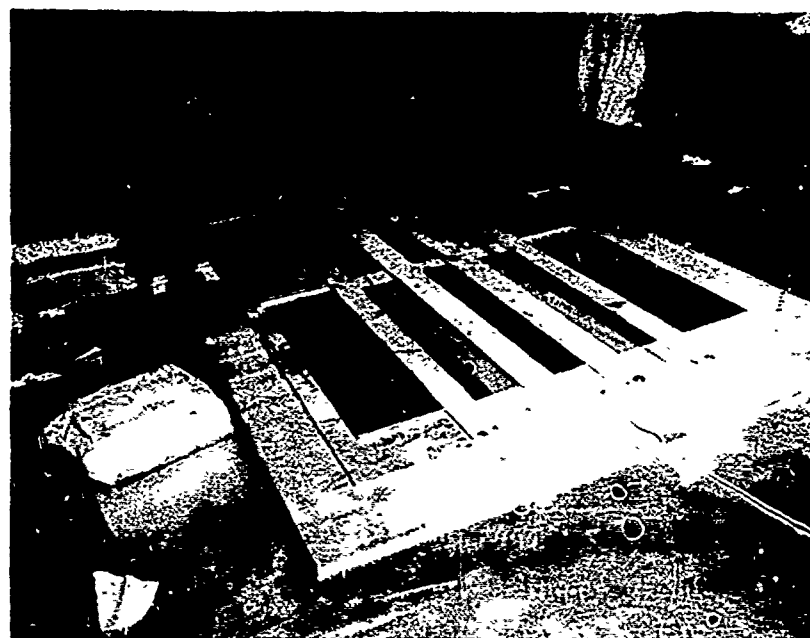


FIGURE 10 LAYUP OF THREE 12" x 18" BONDED PANEL ASSEMBLIES

10. The assembly is bagged by laying two plies of 181 glass cloth bleeder over the part. The chain is used to distribute the air bleed from all portions of the layup to the tool exhaust port. The glass cloth bleeder extends past the chain and is taped to the tool surface. The remainder of the bagging procedure is described in Steps 10 and 11 of Section 2.2.
11. The bagged assembly is then checked for leaks using 10" Hg vacuum. The assembly is installed in the autoclave and again vacuum is released, and the bag is allowed to stabilize at atmospheric pressure for 10 minutes. The pressure is then increased to 30 psig and the heat cycle started. The temperature is increased at a rate of $7^{\circ}/\text{minute} \pm 2^{\circ}/\text{minute}$ until the temperature reaches 250°F . The assembly is held at 30 psig ± 2 psig and $250^{\circ}\text{F} \pm 10^{\circ}\text{F}$ from 60 to 90 minutes (75 minutes nominal). The part is allowed to cool down to 150°F under the 30 psig autoclave pressure. The pressure is then released and the autoclave opened.
12. The assembly is removed from the autoclave and the bonded panels removed from the tool, cleaned, visually inspected, and machined to the test specimen width dimension.
13. Quality control check of the bonding operation is accomplished including metal finger panels which have been processed and primed along with the metal splice plates or adherends and laid up with the same adhesive batch and roll number as used for bonding the assembly. After bonding, these test coupons are tested to determine the lap shear properties of the adhesive system.
14. For machining, the panels are mounted on the table of a milling machine with the 0° fiber orientation lined up with the table axis. The slitting wheel is a 6" diameter by 0.032" thick wheel impregnated with 80-grit diamonds on the wheel periphery. The wheel is rotated at 1750 rpm. The table speed is set for 9"/minute when cutting boron, aluminum, or fiber-

glass and at 2"/minute for cutting titanium. The panel is kept flooded with water coolant during the slitting operation. The panel edge is trimmed 0.25" and the specimens are cut 1.00" wide by indexing the table 1.04" between cuts.

15. After machining, the specimens are checked for lipover of the splice plate which may obscure the bondline. By machining from the boron into the titanium, the lipover is not as pronounced, but some lipover is evidenced on all specimens, probably due to the wiping action of the trailing edge of the blade going in the reverse direction. In order to accomplish bonding measurements (as discussed in the Technical Inspection section), it is necessary to remove all lipover of the titanium. This is done by mounting the specimen on a surface grinder and taking light cuts with the wheel along the edge of the specimen.
16. The specimens are identified with the drawing number and specimen number and a data sheet is prepared (Appendix A) with pertinent information on the fabrication of the specimen.

2.3.1 Phase II Fabrication - Configuration A

All 3" wide Configuration "A" specimens were prepared in a manner identical to that used for preparing the Phase I, Configuration "A" specimens, except for differences in final machined width. A typical specimen is shown in Figure 11.

2.3.2 Phase III Fabrication - Configuration A

The Phase III Configuration A specimens (10 inch wide single splice butt joint) were fabricated using the procedures developed under Phase I of this program. Bonded panels were fabricated 12 inches wide and 18 inches long. This size panel provided allowances for edge trim, a one inch wide control specimen and the required 10 inch wide Phase II specimen. A set of these specimens machined from one panel is shown in Figure 12.

Due to the width of this specimen, provisions had to be made for introducing end loads through bolted loading plates. For this purpose the tab configuration was changed from the basic constant thickness, 3-1/2" long aluminum tab to a stepped titanium tab. The stepped tab was fabricated by bonding an 0.018" titanium (8A1-1Mo-1V) sheet 3.5" wide, an 0.018" sheet 3" wide and an 0.035" sheet 2.5" wide such that the outboard edges of all three sheets were flush and the inboard end was stepped at 0.5" intervals. The titanium sheets were processed for bonding, primed and bonded together with FM123-4, .045 psf at 30 psig and 250°F to form a single prebonded tab. These tabs were then bonded to the ends of the specimens with the same adhesive system using 25" Hg vacuum and 225°F for two hours. These stepped loading tabs can readily be defined in Figure 12.

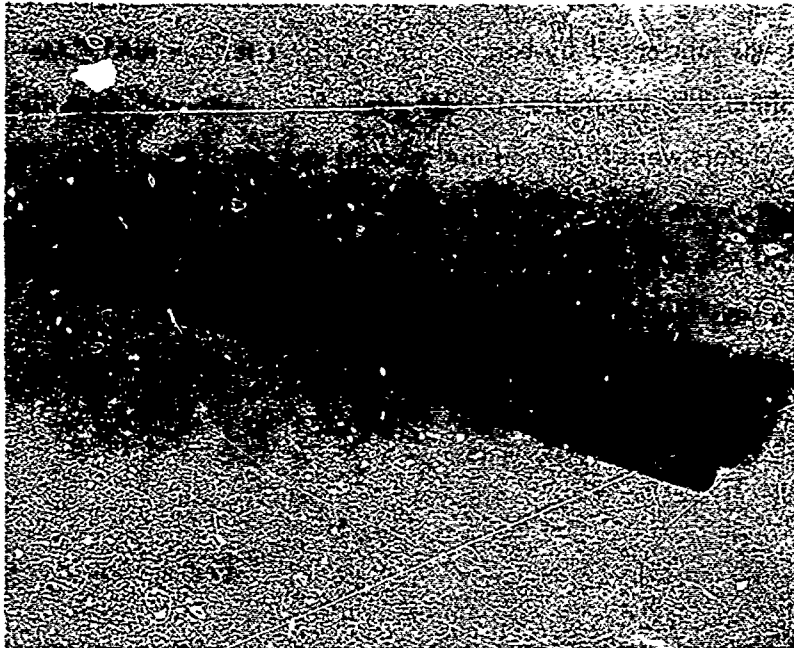


FIGURE 11 THREE INCH WIDE CONFIGURATION A SPECIMEN

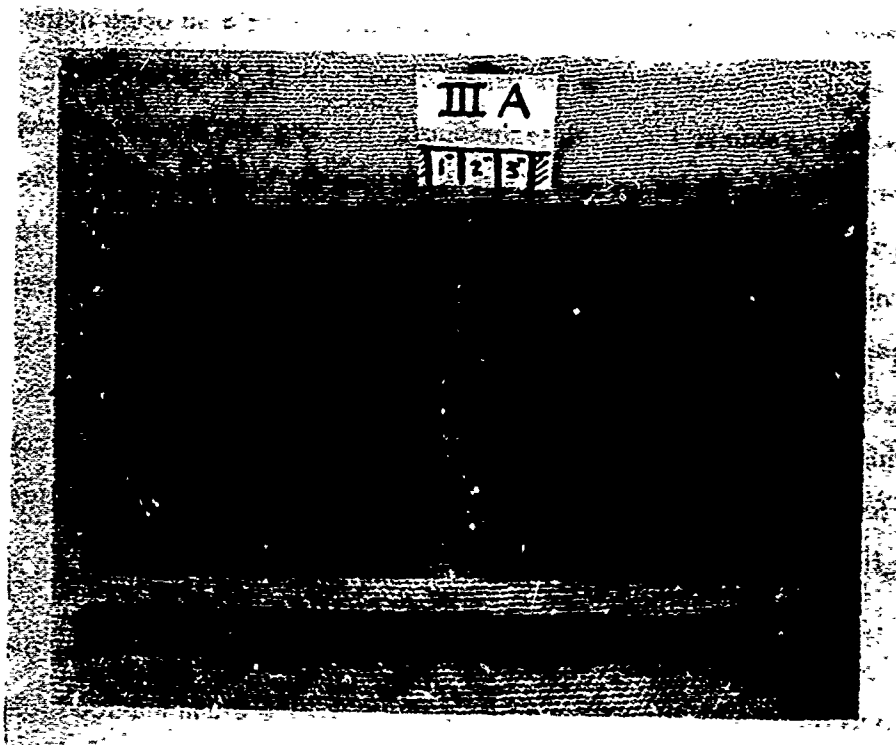


FIGURE 12 PHASE III CONFIGURATION A -
SINGLE SPLICE BUTT JOINT

2.3.3 Alternate Adherend Evaluation - Configuration A Fiberglass Specimens

The fiberglass laminate required for these specimens was fabricated using 3M 1002 S glass prepreg tape (Batch L19, Roll W329). The laminate was a basic 8 ply $(0^\circ/\pm 45^\circ/0^\circ)_2$ orientation, the same ply orientation as the baseline boron specimens, Dwg No. 7226-13021A-1A. The lay-up techniques were comparable to those used for the boron panels fabricated previously under this contract. The laminate was laid up using nylon peel ply on both surfaces and a bleeder system consisting of one ply of 116 glass cloth. The assembly was bagged using standard bagging techniques. The bag was vacuum checked at 28" Hg vacuum for leaks prior to being sent to the autoclave for laminate cure. The autoclave run consisted of the normal vacuum check and the dwell at 10 psig for 10 minutes for stabilization after the vacuum was released prior to increasing the autoclave pressure to 50 psig. After stabilizing the autoclave pressure to 50 psig, a heat up rate of $7^\circ/\text{minute} \pm 2^\circ/\text{minute}$ was used in bringing the laminate up to the 350°F cure temperature. The part was held at this temperature and pressure for a minimum of one hour and then cooled to 150°F under full 50 psig pressure. Quality control specimens of 15 ply unidirectional laminates for flexural testing were laid up and cured with the laminate.

After quality control acceptance, the laminate was machined into two panels $9" \times 15"$. These two panels along with the titanium splice plate and the aluminum load tabs were then prepared for bonding. The peel ply was removed from the fiberglass panel and the faying surfaces were sanded and cleaned before application of adhesive. The metal elements were cleaned and primed in the same manner as used previously for the boron specimens. Adhesive was applied to all surfaces requiring a bond and the assembly was laid up and bonded in the standard autoclave procedure used for previous Configuration A specimens. All bond lines used EA9601, 0.06 lb./ft^2 weight, adhesive cured at 250°F for one hour under 30 psig autoclave pressure.

After bonding, this panel was machined into 1" widths, thus providing 14 fiberglass-to-titanium Configuration A specimens. All specimens were then submitted for inspection and testing.

2.3.4 Alternate Adherend Evaluation - Configuration A Graphite Specimens

The graphite laminate required for these specimens was fabricated using Fiberite Hy E 1311B graphite/epoxy tape (Lot No. 1088, Roll No. 1). The laminate was laid up as an 8 ply, $0^\circ/\pm 45^\circ$ balanced lay-up identical to that used for the baseline boron/epoxy bonded joint specimens. Lay-up procedures and bagging techniques were the same as previously used on boron and fiberglass laminate. Two plies of 116 fiberglass cloth were used as the bleeder system. Nylon peel plies were incorporated on all bonding surfaces. The standard vacuum bag was used over the laminate and was checked for leaks at 28" Hg vacuum. The autoclave cycles used to cure the graphite epoxy was recommended by the supplier and is outlined below:

1. Apply vacuum of 28" Hg and recheck for leaks.
2. Hold vacuum and increase temperature to 200°F at a rate of 3-5° per minute.
3. Hold at vacuum and 200°F for 15 minutes.
4. Release vacuum and increase autoclave pressure to 85 psig.
5. Hold at 85 psig and 200°F for 60 minutes.
6. Increase temperature to 300°F at 3-5° F per minute and hold at 300°F for 60 minutes.
7. Increase temperature to 375°F at 3-5°F per minute.
8. Hold at 375°F and 85 psig for 240 minutes.
9. Cool to 150°F under 85 psig.

A 15-ply unidirectional quality control panel was laid up and cured with the laminate for subsequent acceptance testing. After quality control acceptance the laminate was machined into two panels 9" X 15". These two panels, the titanium splice plate, and the aluminum load tabs were prepared for bonding. Preparation for bonding and bonding procedures were the same as used for the fiberglass panel. As with previous specimens the adhesive used was EA 9601 0.06 lb./ft.² weight which was cured at 250°F for one hour under 30 psig autoclave pressure.

After bonding, the panel was machined into 1" widths, thus providing 14 graphite-to-titanium Configuration A specimens. All specimens were then submitted for inspection and testing.

2.4 JOINT FABRICATION - CONFIGURATION B, BORON TO METAL STEPPED SINGLE SCARF

The Configuration B specimens were fabricated utilizing the co-curing process, i.e., curing the laminate and bonding to the metal adherend during one operation. These specimens are illustrated in Figure 2 which is repeated below. Individual specimens were fabricated according to the requirements of Dwg. No. 7226-13021B, Appendix C.

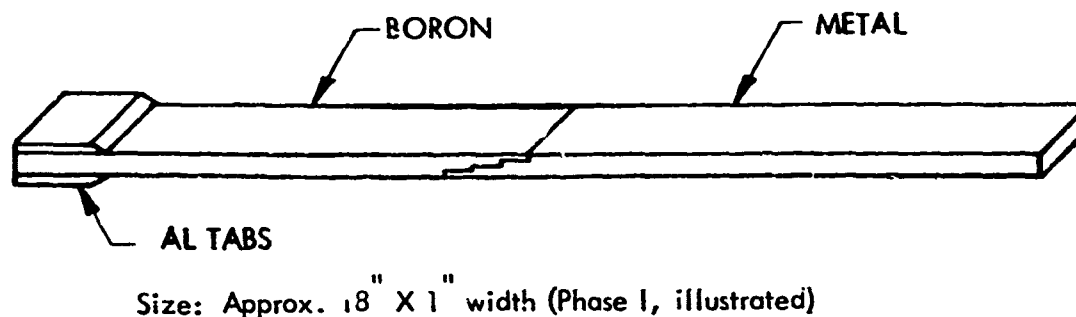


FIGURE 2 - CONFIGURATION "B"
BORON TO METAL STEPPED SINGLE SCARF JOINT

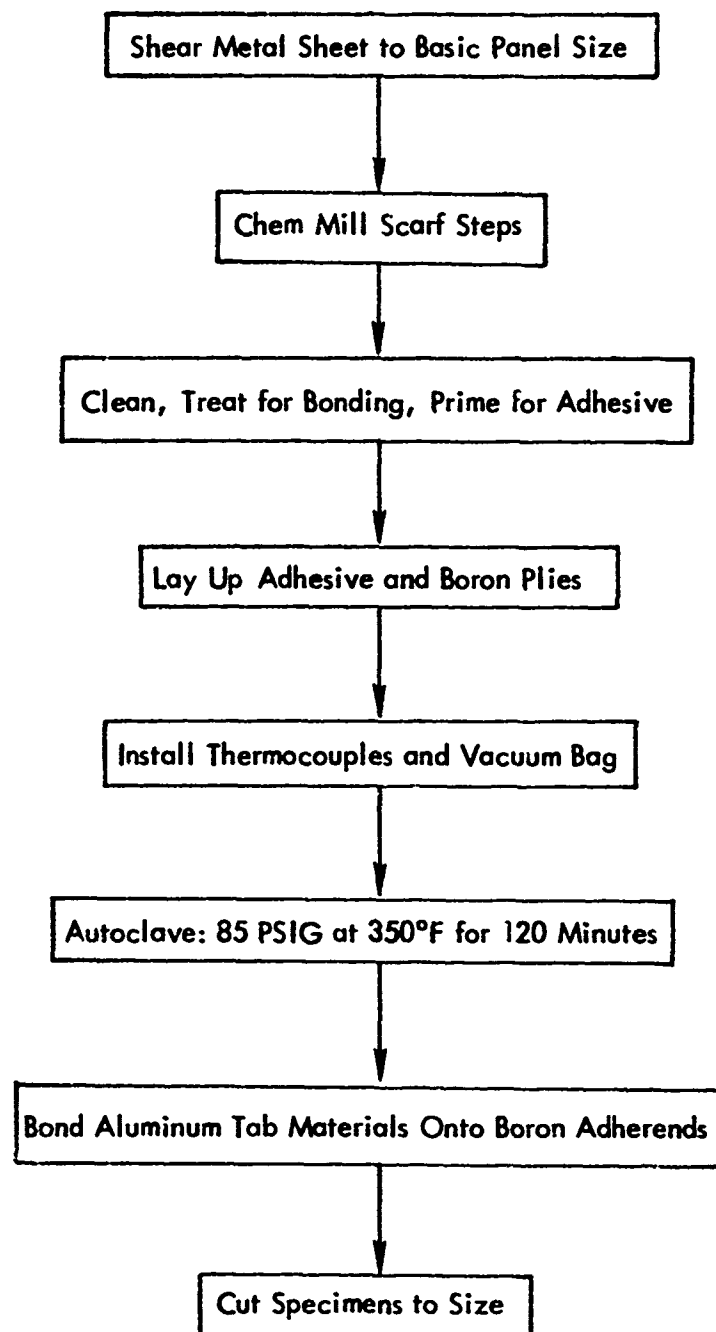


FIGURE 13 - STEP CHART FOR CONFIGURATION "B" SPECIMENS

The steps and procedures followed to produce good quality joints by this process are listed below:

1. The titanium (6Al-4V annealed) and aluminum (7075-T6) are sheared from 0.084" thick sheet into basic panel size per Dwg. No. 7226-1302IB, Appendix C.
2. Due to the warpage generated in mechanically milling the steps on the metallic adherends, the steps are milled chemically. The metal is masked and the steps are generated by raising the metal sheet the required height for the step length after the material from the first step has been removed. Each of the three steps are milled in this fashion. A trim allowance was left on the final step so that it could be cleaned up by machining off the ragged edge generated in the chem-milling process. A radius was left in the corners of the steps varying from 0.010" to 0.030" for the first to the last step, respectively. The chem-milling was held within the ± 0.002 " specified on the drawing.
3. After machining, the chem-milled panels are recleaned, chemically treated for bonding, and primed with the adhesive primer.
4. The adhesive, EA9601, 0.045 lb/ft² weight, is laid up on the steps of the joint. The metal adherend is placed on the tool with a sheet of Mylar film and Teflon-coated glass between the part and the tool surface. Four plies of boron are laid up butting the edge of the first step. Four additional plies are laid up over the first step and butting the end of the second step. This layup is continued with four plies of boron per step until all steps were covered. The orientation of the laminate is specified on Dwg. No. 7226-1302IB.
5. The bagging and curing procedures of these panels are identical to those described for the basic laminate fabrication (Section 2.2, Step 5 through Step 16). The metal portions of the specimens are covered with Teflon tape to prevent resin build-up during the cure cycle and the bleeder system covers only the boron laminate portion of the panel.

6. The boron adherends are tabbed with the aluminum tab materials in a secondary bonding operation.
7. The specimens are cut to size using the same techniques as described for the Configuration "A" specimens (refer to Section 2.2, Steps 14 and 15). See Figures 14 and 15.

2.4.1 Phase II Fabrication - Configuration B

Fabrication of the 3 inch wide Configuration B specimens (boron-to-metal step scarf joint) is detailed below.

The basic 6Al-4V titanium sheet (9" X 13") used for the Configuration "B" specimens was 0.084" in thickness. The titanium was chem-mill masked over all areas where the metal was not to be removed. The nominal basic steps that were chem-milled are 0.020" in depth with step lengths of 0.500" and 0.375". The protective mask was removed in incremental steps as required to obtain the three required step lengths and depths. The specimen was checked periodically during the chem-milling process to verify proper material removal and to assure acceptable step depths.

After the chem-milling process was completed, the titanium was prepared for metal bonding. The treatment used for titanium preparation was in accordance with paragraph 6.1.6 of MIL-A-9067C. The basic steps were solvent wipe, vapor degrease, acid pickle, water rinse, phosphate/flouride immersion, water rinse, hot water soak, distilled water spray, and air dry. The areas to be bonded, i.e. the steps, were primed with EA 9201 primer immediately after completion of the titanium surface treatment. The adhesive, EA 9501-045 psf, was then applied to the faying surfaces and the boron was laid up with 16 plies, 0° ±45° orientation. The total assembly (13" X 18") was cocured at 85 psig and 350°F for 2 hours.

Similar procedures were followed in the preparation of the 7075-T6 aluminum/boron step joint specimens. The metal bond preparation for the aluminum was the normal metal bond etch followed by immediate priming with the EA 9201 primer. The boron half of the cured specimen panel was tabbed using aluminum tabs. The same procedures were used in bonding the tabs as previously described for the Configuration "A" specimens.

The cured panels were then cut into 3" wide specimens and submitted to Quality Assurance for checking the titanium/boron and aluminum/boron bond lines for both integrity and thickness. A typical specimen is shown in Figure 16.

2.4.2 Phase III Fabrication - Configuration B

The ten inch wide Phase III Configuration B specimens (boron-to-metal step scarf joint) specimens were fabricated in the same manner as discussed for the Phase II, 3-inch wide specimens. Bonded panels for these specimens were fabricated 12 inches wide thus providing sufficient width for a 10-inch wide fatigue specimen, a one inch wide control specimen and edge trim. Machined specimens are shown Figure 17.

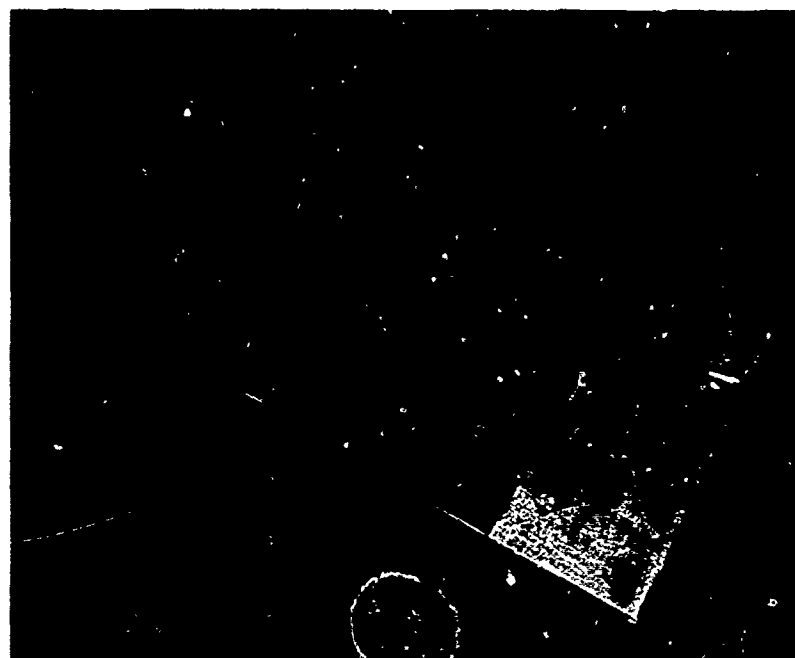


FIGURE 14 BONDED PANEL ASSEMBLY
CONFIGURATION "B" SPECIMENS



FIGURE 15 MACHINED CONFIGURATION "B" SPECIMENS

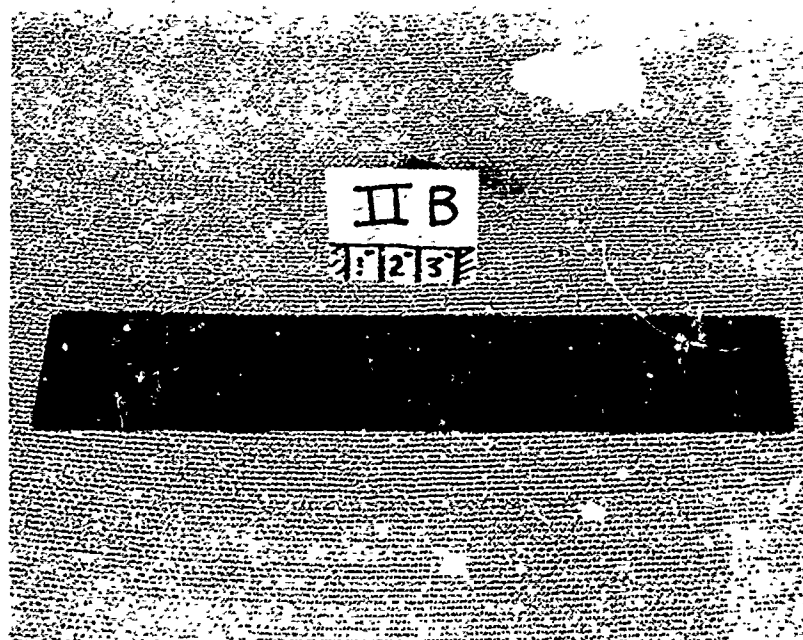


FIGURE 16 PHASE II CONFIGURATION B -
STEP SCALF BONDED JOINT

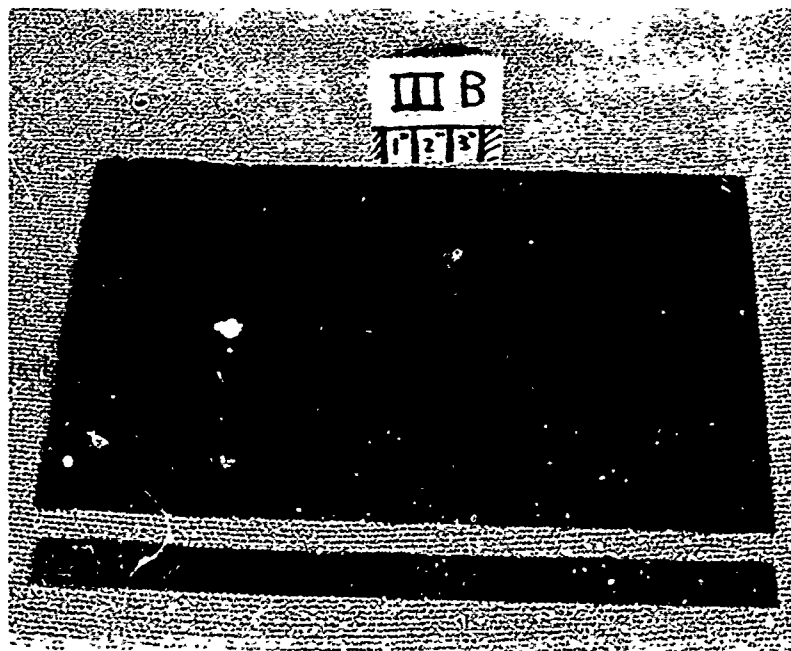
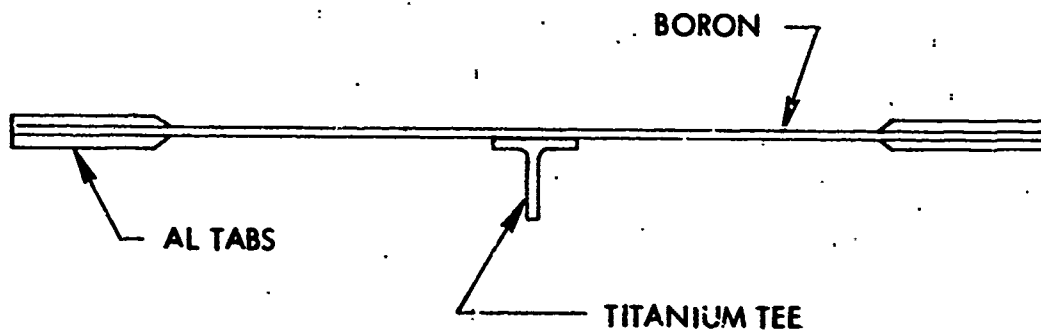


FIGURE 17 PHASE III CONFIGURATION B -
STEP SCARF BONDED JOINT

2.5 JOINT FABRICATION - CONFIGURATION C, SURFACE TO UNDERSTRUCTURE ATTACHMENT, BONDED

The Configuration C specimens were fabricated using precured laminates made as described in Section 2.2. These specimens are illustrated in Figure 3, which is repeated below. Individual specimens were fabricated according to the requirements of Dwg. No. 7226-1301C, Appendix C.



Size: 18" X 1"

FIGURE 3 - CONFIGURATION "C"
SURFACE TO UNDERSTRUCTURE ATTACHMENT - BONDED

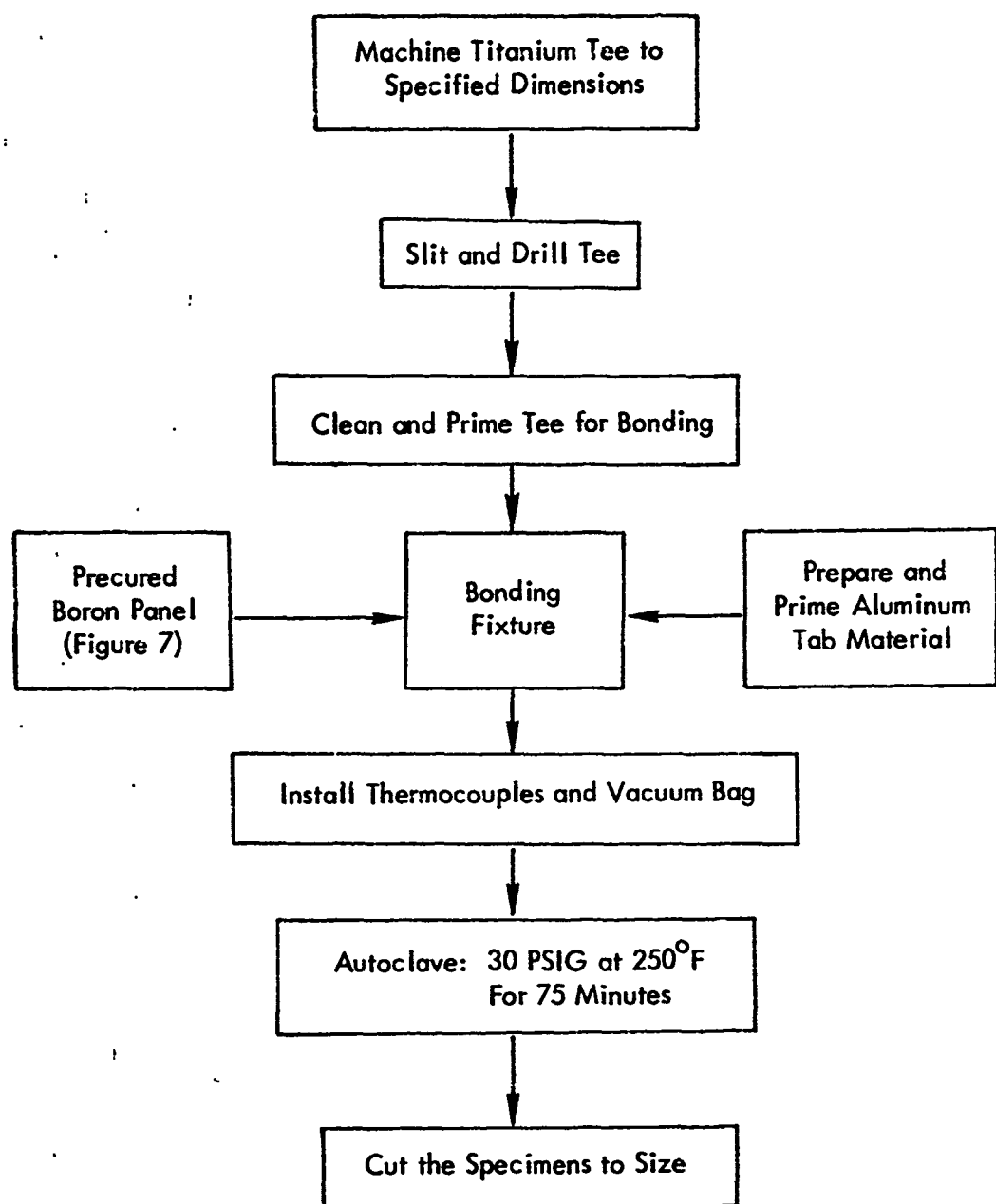


FIGURE 18 - STEP CHART FOR CONFIGURATION "C" SPECIMENS

The following steps and procedures were taken to maintain uniformity and quality of the bond joint between the metal "tee" and the boron laminate:

1. A titanium tee extrusion (6Al-6V-2Sn) is machined to the cross-sectional dimensions specified on Dwg. No. 7226-13021C (Appendix C). The tee is then slit across the leg and into the cap, allowing for the 1.00" width between cuts and leaving 0.06" on the cap for continuity. The slitting is done to minimize the machining of titanium after bonding. Holes are drilled 0.50" from the end of the leg and centered between the slits.
2. The titanium is chemically cleaned and primed for bonding.
3. The aluminum tab material is cleaned, metal bond etched, and primed for bonding.
4. The lower tabs are positioned on the bonding fixture and the AF123-2, 0.06 lb/ft² weight, adhesive is laid on the faying surface.
5. A precured panel with the proper ply orientation is cut the required size to produce the specified number of specimens. The peel ply is then removed from the boron panel and the panel positioned over the lower tabs.
6. The upper tabs are covered with the AF123-2, 0.06 lb/ft² weight, adhesive and are positioned using the pinned tab locators.
7. The primed titanium tee is prepared for bonding by applying the EA9601, 0.06 lb/ft² weight, adhesive to the upper cap surface which is then inverted and positioned on the boron laminate. The cap is held in place using splice plate locators and spacers to compensate for the width variation of 0.27" between the tee cap and the splice plate.
8. Conventional bagging techniques are used in bagging over the tee section. Plies of fiberglass cloth are laid up to round off the area on either side of the upstanding leg of the "tee".

9. The procedures outlined for bagging and curing the Configuration "A" specimens (Steps 9-13) are followed for this bonding operation.
10. For machining the panel into 1.00" specimens, the procedures outlined for machining Configuration "A" specimens (Steps 14 and 15) were followed. The saw cuts in the titanium are used as indexing points for cutting the laminate, tabs and the balance of the titanium tee. Since the original cut in the titanium is 0.090" wide and the diamond saw cut is 0.040" wide, the specimens are set up on a surface guider to machine the 0.025" excess off from each side of the laminate.
11. After visual inspection, the specimens are identified with the drawing number and specimen number, and a data sheet is prepared (Appendix A) with pertinent information on the fabrication of the specimen. Specimens are shown in Figures 19 and 20.



FIGURE 19 THREE CONFIGURATION "C" SPECIMENS

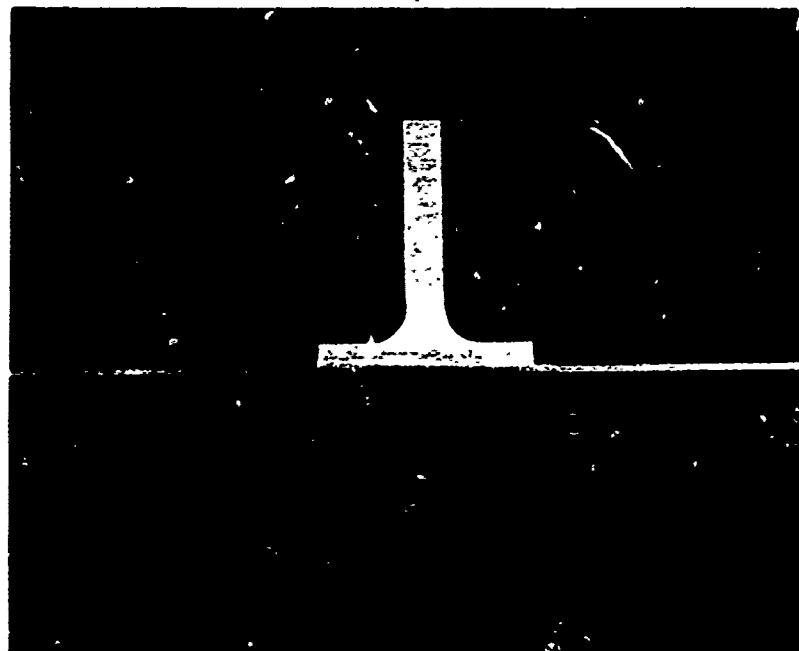
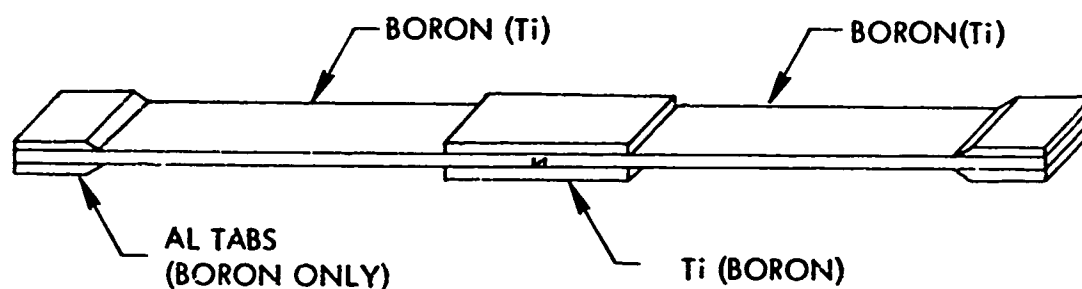


FIGURE 20 EDGE VIEW OF CONFIGURATION "C" SPECIMEN

2.6 JOINT FABRICATION - CONFIGURATION D, DOUBLE SPLICE BUTT, BONDED

Configuration "D" specimens were fabricated according to the requirements of Dwg. No. 7226-1302ID, Appendix C. The same procedures were followed in fabricating the Configuration "D" specimens as were used for Configuration "A". Tooling was modified to allow for the location of the lower splice plate directly under the upper splice plate. Provisions for keeping the adhesive from flowing between the butt ends of the adherends were not made for the "D" specimens, since the presence of adhesive in this area is not deemed detrimental to the required tension-tension testing. The upper splice plate was located using the normal splice locators as discussed for Configuration "A". Configuration "D" specimens were made both with boron joined adherends (main load plates) matched with titanium splice plates, and with titanium joined adherends matched with boron splice plates. These specimens are illustrated in Figure 4, which is repeated below.



Size: Approx. 18" X 1"

FIGURE 4 - CONFIGURATION "D" DOUBLE SPLICE BUTT JOINT - BONDED

2.7 JOINT FABRICATION - CONFIGURATION E, SINGLE SPLICE BUTT, BOLTED

These specimens are illustrated in Figure 5, which is repeated below. Individual specimens were fabricated according to the requirements of Dwg. No. 7226-130IE, Appendix C.

Configuration "E" Single Splice Butt Joint - Bolted
Size: Approx. 18" X 1" width (Phase I, illustrated)

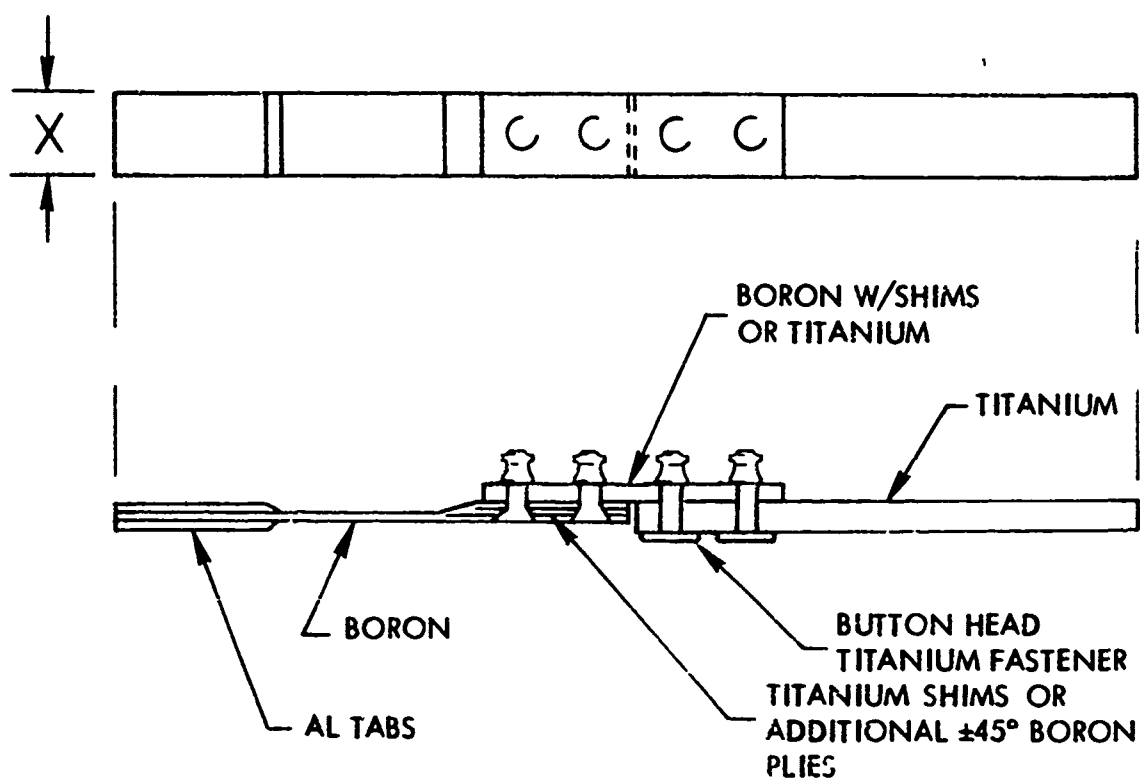


FIGURE 5 (REPEATED)

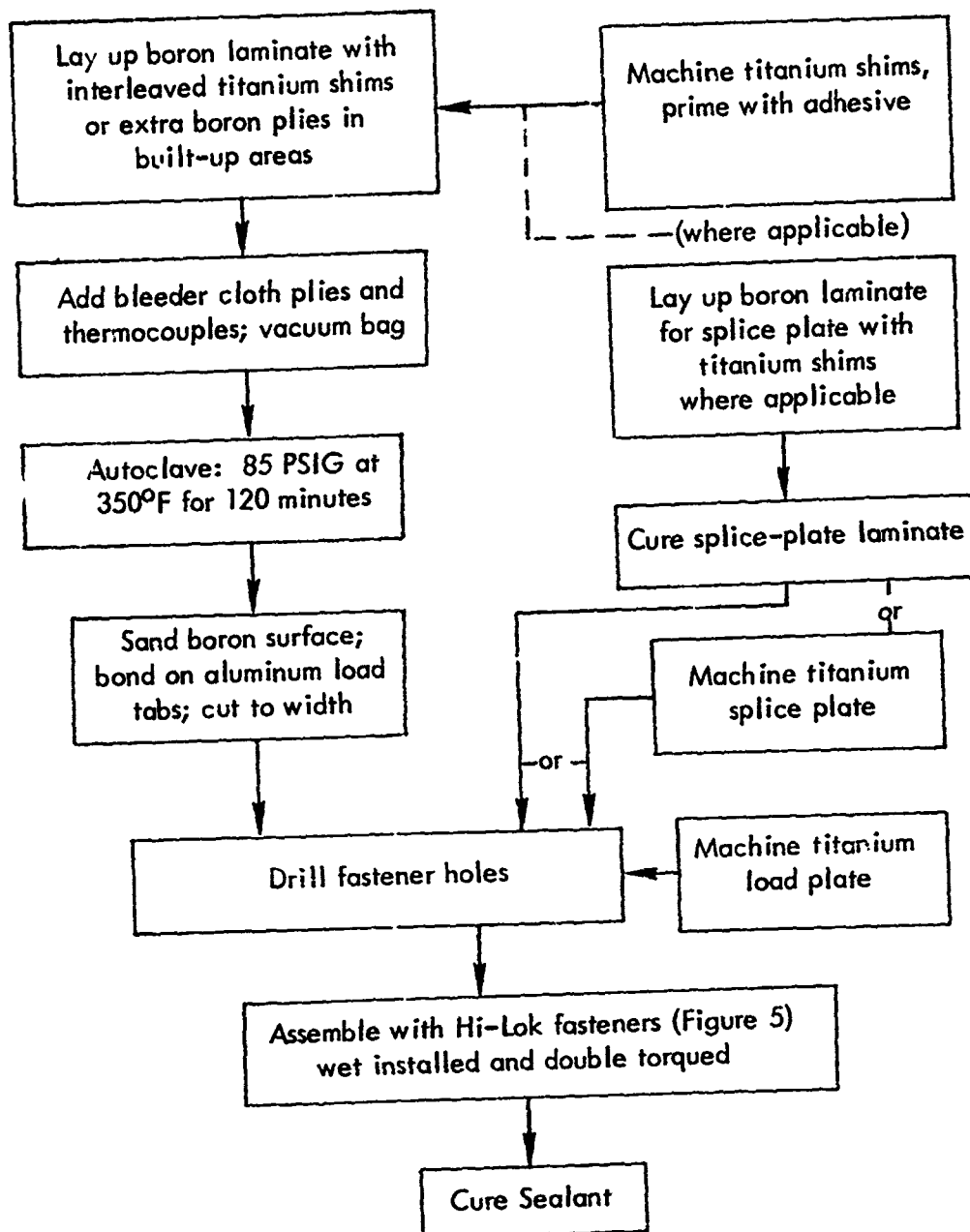


FIGURE 21 - STEP CHART FOR CONFIGURATION "E" SPECIMENS

The lay-up procedure for the basic boron panel laminate thickness for the composite side of the Configuration E specimens was similar to that described in Section 2.2. The boron plies were laid up in large sheets with the specimen details cut to length and width after the laminate had been cured. However, since the mechanical joints require additional built-up areas for providing the bearing strength to reach the fastener loads, these build-ups were incorporated in the ends of the laminate during the lay-up operation.

The build-ups were achieved either by interleaving titanium shims or additional pairs of $\pm 45^\circ$ boron plies among the basic laminate plies. See Drawing 7226-13021E in Appendix C for exact stacking sequences. The additional shim or plies were staggered in length to provide a smooth transition from the basic laminate to the build-up area. Prior to lay-up, titanium shims were machined to size, processed for bonding, and primed. The primed titanium shims were then overlaid with 0.045 lb./ft² weight EA9601 adhesive and placed in the laminate as required.

The resin bleeder system and the bagging procedures followed were similar to those used for the Basic Laminate Panels, Section 2.2, except that no peel plies were used. An autoclave cycle of 85 psig and 350°F for 120 minutes was employed. Quality control specimens were included with the panel lay-up to verify the material properties.

After cure, the laminate was cut with a diamond saw into panels 9 inches long and of sufficient width to provide 9 to 24 one-inch-wide specimens. The load grip ends of the panel were tabbed with aluminum tabs. The boron surface was sanded, the aluminum tab material was metal bond etched and primed, adhesive was placed between the aluminum tabs and the boron, and then the assembly was bagged and cured at 250°F for 60 minutes under 20" Hg vacuum. The panels were then cut into specimen details 1" wide by 9" long using a diamond saw on a milling machine. Excess coolant was used and the mill feed rate was decreased when the cut was made through the titanium-boron build-up area to reduce the possibility of laminate overheating.

The titanium joint details were machined 1" x 9" to form the second half of the joint. Also, the titanium splice plates or boron-titanium shim splice plates were machined to 1" width and to the length necessary for providing the required edge distance for the fasteners. Specimen components prior to assembly are shown in Figure 22.

The holes for the fasteners were drilled using a diamond core drill. No problems were encountered in drilling the boron-boron laminates. However, considerable difficulties were encountered in drilling the boron-titanium specimens.

In order to provide quality holes for these specimens, it was necessary to change tools during the drilling operation. This was done on a milling machine using a core drill for the boron and an end mill for the titanium. This procedure eliminated overheating of the specimen during drilling and provided a hole free from lip-over in the titanium which results from a one step diamond drilling operation. Good back-up of the laminate was used to prevent fiber breakout on the back side of the hole. The holes were countersunk using diamond countersinks. No problems were encountered and all countersunk holes had good visual surface characteristics. The specimens were spot checked by ultrasonics to determine if any delamination occurred during drilling and none was found.

Specimens were assembled using Hi-Lok fasteners. The fasteners were wet installed and the faying surfaces were coated with a sealant in accordance with standard assembly procedures for mechanically fastened joints. The fasteners were torqued to 30 inch-pounds ± 1 inch-pound and re-torqued after approximately 30 minutes to account for any squeeze-out of the faying surface sealant. The assembly was then baked for 48 hours at 160°F to cure the sealant. Three completed joints are shown in Figures 23 and 24. The three specimens shown represent thick laminate-to-metal, thin laminate-to-metal and laminate-to-laminate combinations.

Initial fatigue tests of the Configuration E specimens, composite-to-metal mechanical joint, resulted in failure of the metal portion of the joint. A number of attempts were made to correct this deficiency. The first attempt replaced the 7075-T6 aluminum

portion of the joint with 8Al-1Mo-1V titanium of equal thickness but these specimens failed in the countersunk portion of the titanium. This led to the replacement of the BL19PB6 flush head fasteners by HL18PB6 button head fasteners for the metal-to-metal portion of the joint but this only moved the failure to the titanium splice plate.

This second failure mode led to the final design which consisted of the boron portion joined to 8Al-1Mo-1V titanium which was 50 percent thicker than the composite. These specimens were assembled with flush head fasteners, HL19PB6 series, used on the boron-to-titanium half and button head fasteners, HL19PB6 series, used on the titanium-to-titanium half. Fatigue tests on two specimens of this configuration resulted in fatigue failures of the boron portion of the joint. Based on these results, all of the Configuration E specimens were disassembled and new metal splice plates and metal joint halves were machined from 8Al-1Mo-1V titanium; 0.125" material was used with the 8-ply boron specimen halves and 0.250" material was used with the 16-ply boron specimen halves. The Configuration E design, Dwg. No. 7226-1302IE, was revised to reflect these required changes. All specimens were reassembled to the new configuration. One baseline specimen (1A60) and one thickness effects specimen (11A06) are shown in Figure 25.

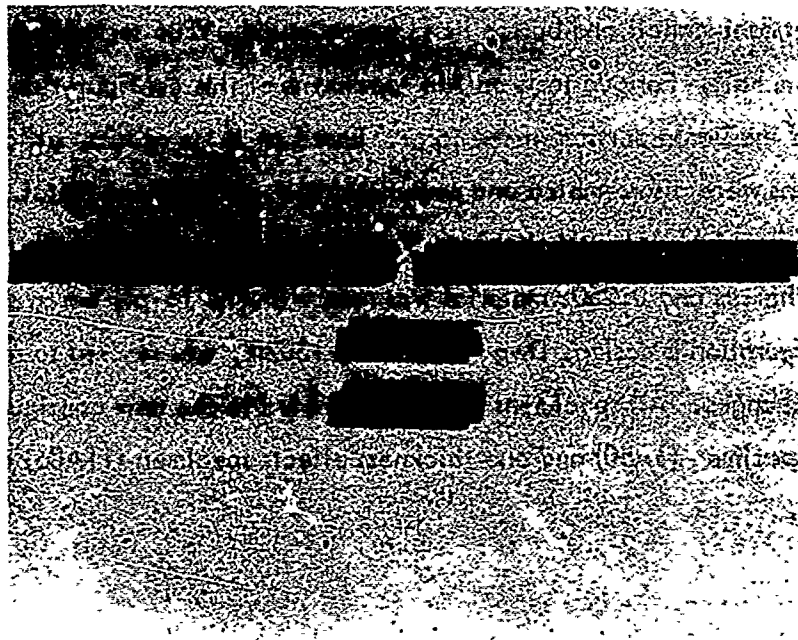


FIGURE 22 CONFIGURATION E SPECIMEN DETAILS

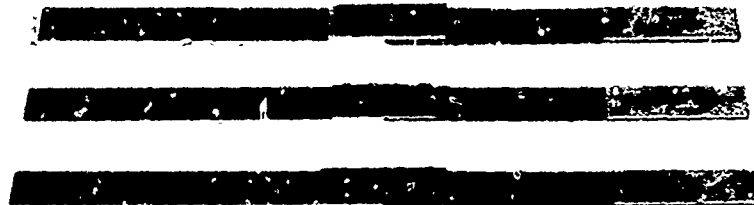


FIGURE 23 CONFIGURATION E COMPLETED SPECIMENS

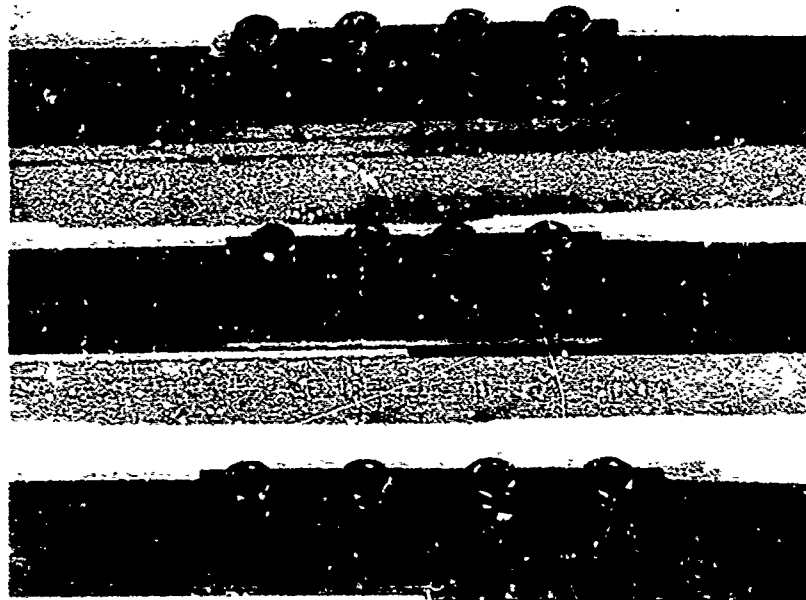
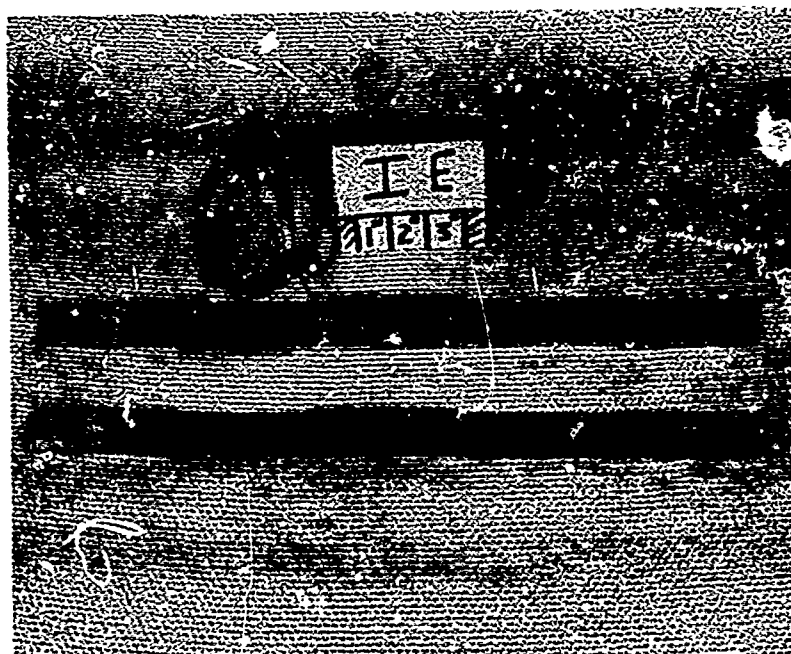


FIGURE 24 CONFIGURATION E JOINT CLOSE-UP



Reproduced from
best available copy. 

FIGURE 25 CONFIGURATION E - MECHANICAL JOINTS

2.7.1 Phase II Fabrication - Configuration E

The laminate portions and splice plates for these specimens were identical to the Phase I Configuration specimens in materials, thicknesses, and configurations except that they were wider. Phase II specimens were two inches wide and contained two rows of fasteners, whereas the Phase I specimens were one inch wide and contained only one row of fasteners.

All specimens were match drilled and countersunk in the boron. Flush head fasteners were used on the boron to splice plate portion of the joint, and button head fasteners were used on the splice plate to loading plate portion of the joint. All fasteners were wet installed with double torquing operations to account for relaxation of fastener torque due to sealant squeeze-out.

Photographs of failed specimens are included in the TEST PROGRAM section of this report.

2.8 JOINT FABRICATION - CONFIGURATION F, SURFACE TO UNDERSTRUCTURE - MECHANICAL

These specimens are illustrated in Figure 6, which is repeated below. Individual specimens were fabricated with one of two laminate thicknesses according to the requirements of Dwg. No. 7226-130IF, Appendix C.

Configuration "F" Surface to Understructure Attachment - Mechanical
Size: 18" X 1" width

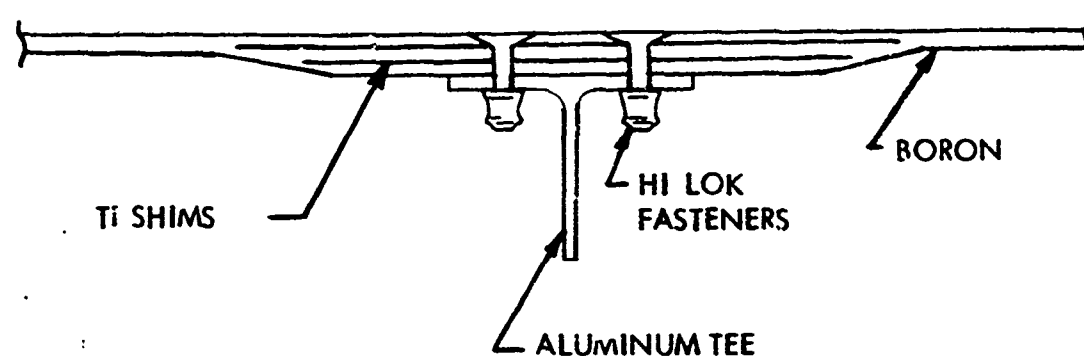


FIGURE 6 (REPEATED)

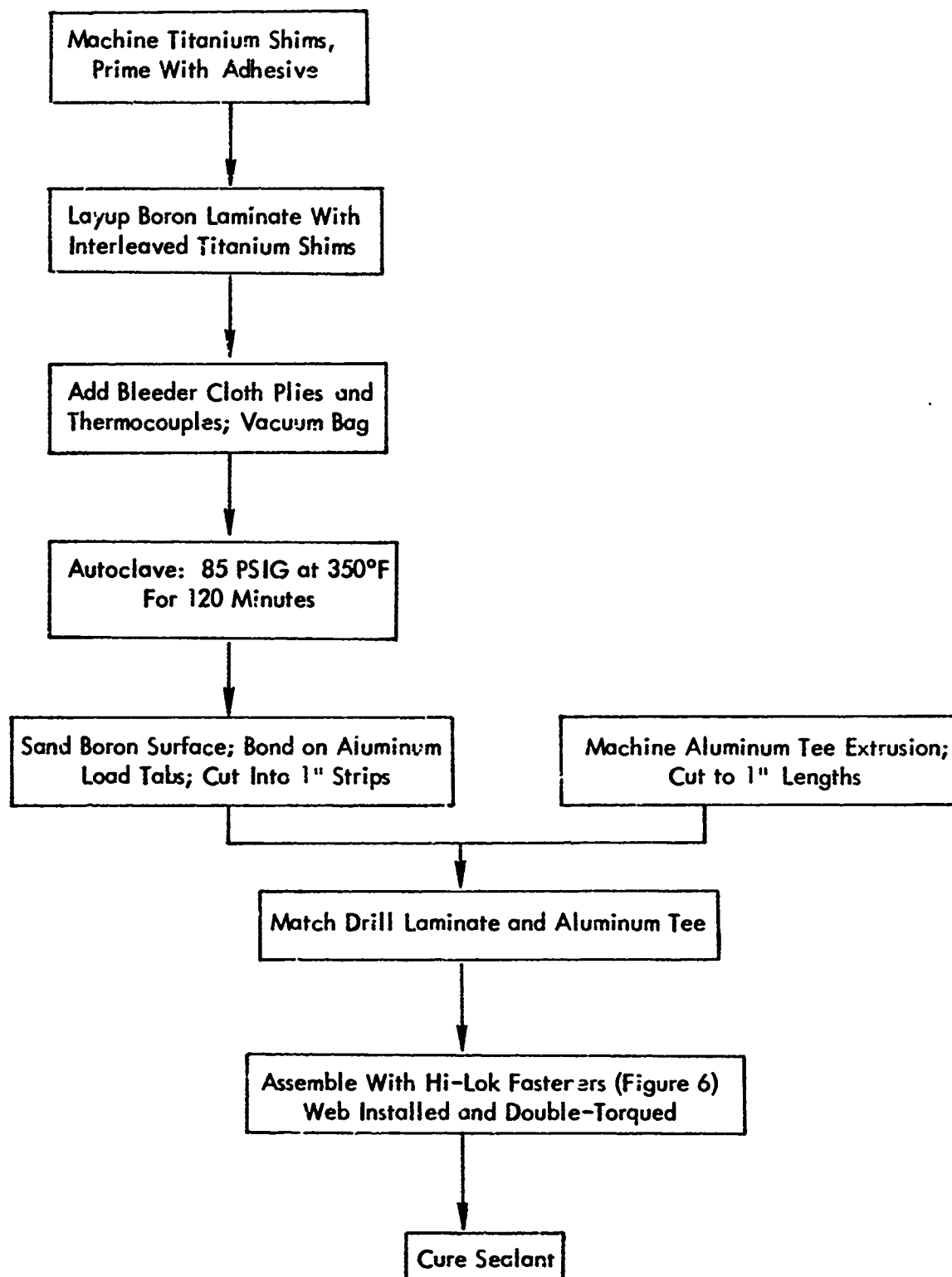


FIGURE 26 - STEP CHART FOR CONFIGURATION "F" SPECIMENS

Laminates were laid up and fabricated according to the size, orientation, and requirements of Dwg. No. 7226-13021F, Appendix C. Panels contained either 8 or 16 boron plies of $0^\circ/\pm 45^\circ$ orientation. The 8-ply panels had titanium shims of 0.012" thickness sandwiched between the second and third, and the sixth and seventh boron plies. The 16-ply panels had titanium shims between the second and third, sixth and seventh, tenth and eleventh, and fourteenth and fifteenth plies.

The shims were staggered in length to provide a smooth transition from the build up area to the basic laminate. Prior to layup, titanium shims were machined to size, processed for bonding, and primed. The primed titanium shims were then overlaid with 0.045 lb./ft² weight EA9601 adhesive and placed in the laminate as required.

The resin bleeder system and the bagging procedure followed were similar to those described in Section 2.2 except that no peel plies were used. Panels were cured in an autoclave cycle of 85 PSIG and 350°F for 120 minutes. After cure the laminate surface was sanded and primed aluminum tab material was applied in a secondary bond operation (250°F for 60 minutes under 20" Hg vacuum). The laminate was then cut into 1" strips.

The aluminum tee was machined into the required one-inch long sections and match drilled with the laminate. Holes through the boron/titanium shim laminate were generated with a core drill and final sized with a diamond reamer. The laminate was countersunk with a diamond tool and the specimen was assembled using flush head fasteners, HL19PB6 series, wet installed. Fasteners were initially torqued to the required 30 inch-pounds and after 30 minutes were torqued again to 30 inch-pounds to account for any relaxation due to squeeze-out of the faying surface sealant. The assembly was then baked for 48 hours to cure the sealant.

Photographs of failed Configuration F specimens are included in the TEST PROGRAM section of this report. These photographs show a close-up of the joint area.

SECTION III

TECHNICAL INSPECTION AND QUALITY ASSURANCE

3.1 INTRODUCTION

This section contains the information related to nondestructive inspection of the fatigue phenomenon investigation specimens, destruct test verification of the base filamentary composite materials, and process and material assessment testing and evaluations. A description of techniques, summary of test data, and presentation of findings are presented below. An itemized listing of associated data are presented in Appendices A, B, and C.

3.2 NONDESTRUCTIVE EVALUATION OF BONDED COMPOSITE JOINTS

The nondestructive evaluation of the bonded joints in this investigation was intended to detect conditions apparent using current state-of-the-art techniques including ultrasonic, visual, microwave, and radiography methods where applicable. The plan by which the evaluations would be accomplished was primarily to:

- o Determination of the detrimental conditions which must be non-destructively evaluated
- o Determine which acceptable conditions affect the evaluation data in the same manner as the aforementioned
- o Utilize specific nondestructive evaluation disciplines and techniques to detect the unwanted conditions

Although the evaluation was expected to detect conditions such as disbonds, delaminations, fiber separation, inclusions, porosity, cracks and bondline thickness variation, additional information was gained during the investigation. This information has been used to reestablish the relative effectiveness of some NDE disciplines in composite evaluations and to recommend factors to be considered in future work.

Since there are many defects which can affect the quality of a bonded joint which varies in nature and characteristics, no single nondestructive test can be expected to evaluate a composite joint for all defects. Ultrasonics, x-ray, microwave and visual tests have

each been used to assure a full evaluation of the bond joint. The preferred test method appears to be ultrasonics since this procedure detected most of the defect conditions and provided additional information yielded by the attenuation of sound in the specimen.

Initially the intention was to detect a defect in the specimen with the ultrasonic procedure, then define the location of the defect with x-ray laminography. Laminography is a relatively new technique of radiography which allows an incremental radiographic analysis of a thin section within a thick sample without physically sectioning the sample. The analysis is accomplished by averaging the unwanted image over a large area while the image of interest remains defined. This result is achieved by synchronously rotating both the film and the sample during the exposure. After examining several joint specimens with this system, it was determined that conventional radiography would provide adequate information for this program.

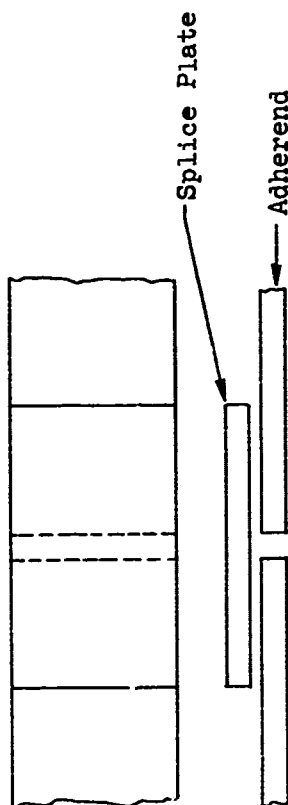
A more detailed discussion of each of these inspection methods is given in the following paragraphs.

3.2.1 Ultrasonic Inspections

All ultrasonic evaluations were performed with an immersion pulse-echo technique. A permanent C-scan recording as in Figure 27 was made for all joints evaluated ultrasonically. The equipment, shown in Figure 28, with which the inspections were made, is a Sperry Immersion C-scan System, Reflectoscope Model UM 721.

The immersion technique used measures variations in ultrasonic attenuation (loss of sound) as the sound traveled through the specimen to a mirror then back through the specimen to the part. The recorder was activated by preset strength levels of the returning ultrasonic energy as shown in Figure 29. The attenuation contributed by the water in the immersion tank and the mirror was assumed to be constant throughout this investigation.

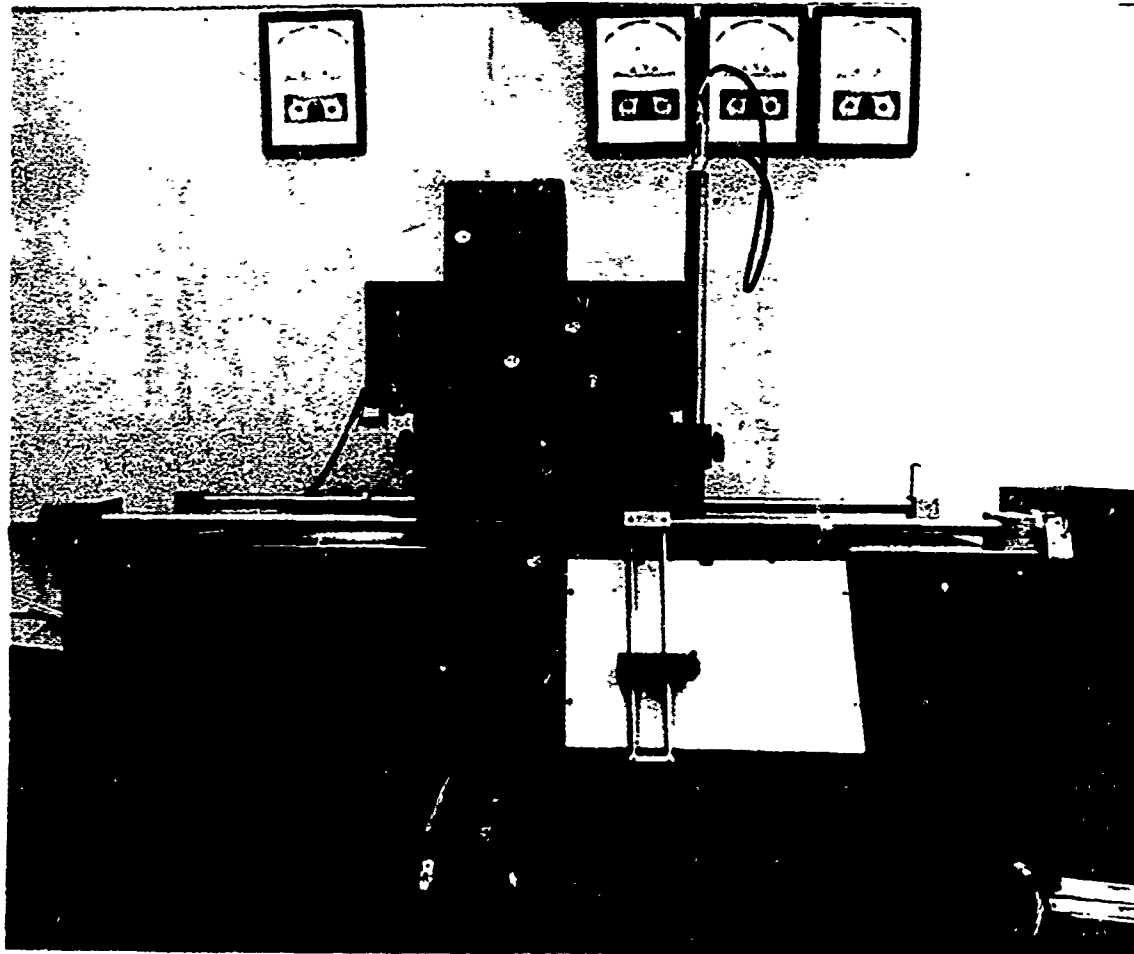
Attenuation is increased by the presence of variation in consistency such as the following defects: porosity, disbonds, inclusions, voids (gross porosity), delaminations, specimen surface roughness, bondline thickness, and resin-starved areas of the composites.



Reproduced from
best available copy.

Joint specimens are scanned five times at various gate sensitivity levels. Dark areas indicate less sound is getting through. Sensitivity is decreasing from left to right.

FIGURE 27 - TYPICAL C-SCAN RECORDING



Specimens are immersed in water and scanned automatically using the pulse-echo technique. Recordings are made of all inspections.

FIGURE 28 - ULTRASONIC C-SCAN INSPECTION SYSTEM

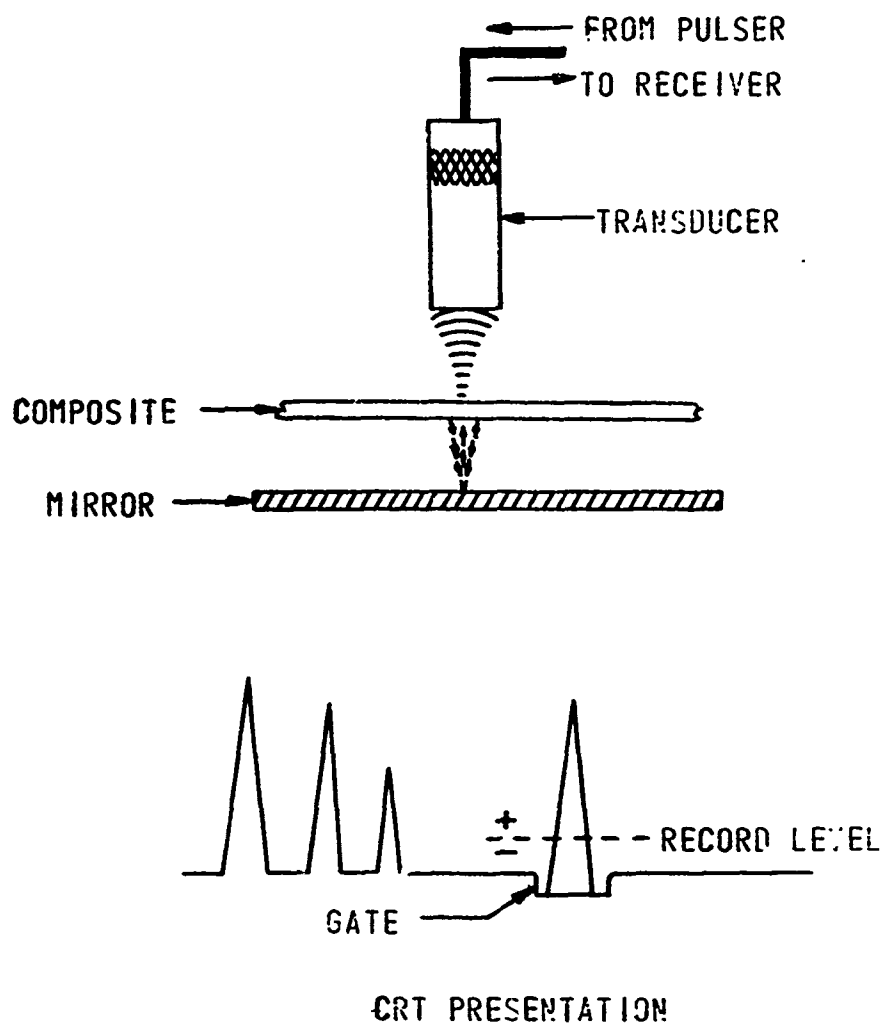


FIGURE 29 - PULSE-ECHO TECHNIQUE

3.2.1.1 Disbonds, Voids, Delaminations - These conditions completely stop penetration of ultrasonic energy through the specimen if the defect size is greater than the .117 square inch area of the ultrasonic energy beam impinging on the specimen surface. Of course the energy transmitted will be proportional to the inverse of the area above. The larger defect will be outlined on the C-scan plan recording. These conditions were rated as go or no-go since normally, if any voids, etc., exist, the specimen was usually completely bad. The evaluation was described as go or no-go since the sound is either transmitted through the specimen or completely stopped.

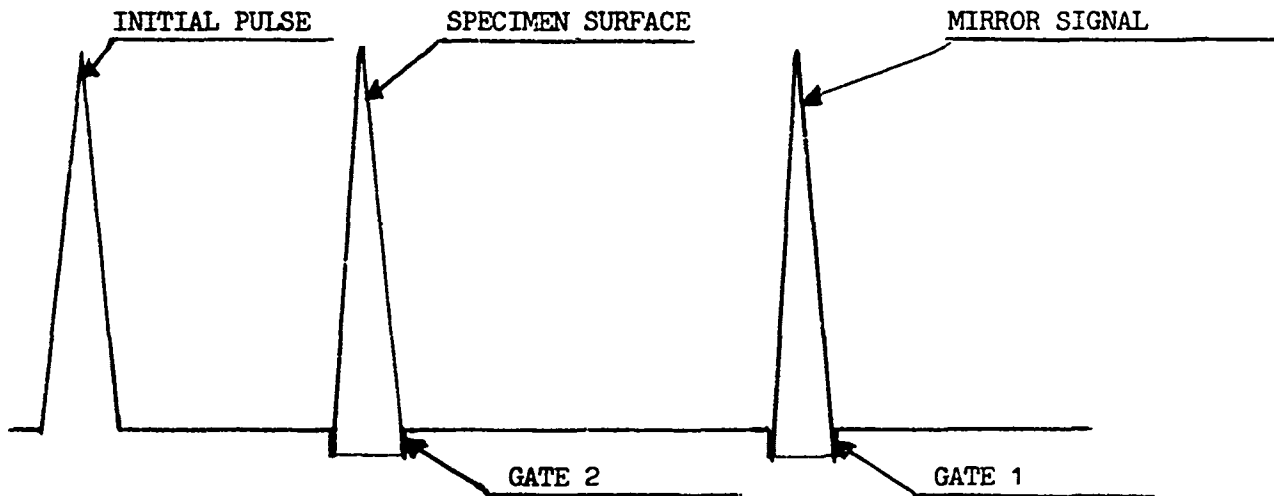
3.2.1.2 Porosity Inclusions - The effective sound blocking area of these conditions was usually less than the area of the sound beam impinging on the specimen surface. Porosity in sufficient concentration to completely block all sound could be visually detected at the edge of the bondline. Adequate in-process control can eliminate the porosity such that no significant decrease in bondline strength results. Inclusions were classified in the same evaluation category as porosity. Radiography was used to detect inclusions.

The effect of these two conditions was not considered on the C-scan read-out unless:

- o The porosity was visually detected during bondline measurements.
- o Radiographic inspection detected foreign material in the bondline or composite.

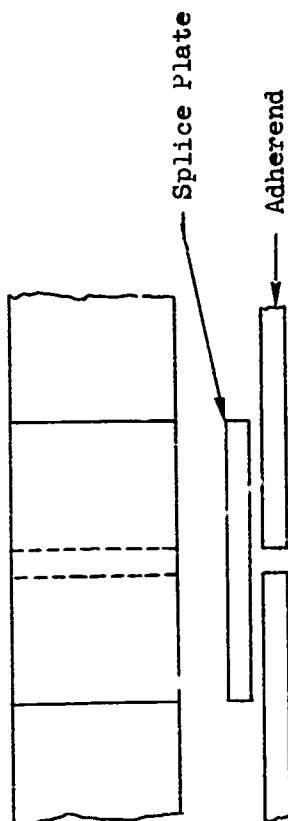
The attenuation of the ultrasonic energy was attributed to other conditions if the aforementioned did not exist.

3.2.1.3 Surface Roughness - This condition, while not always considered defective, had an adverse effect on the energy returning to the transducer. The rough surface scattered the sound away from the main beam, therefore the returning sound energy was lessened. The returning signal (Figure 29) decreased in amplitude and was printed on the C-scan chart as a high attenuation area.



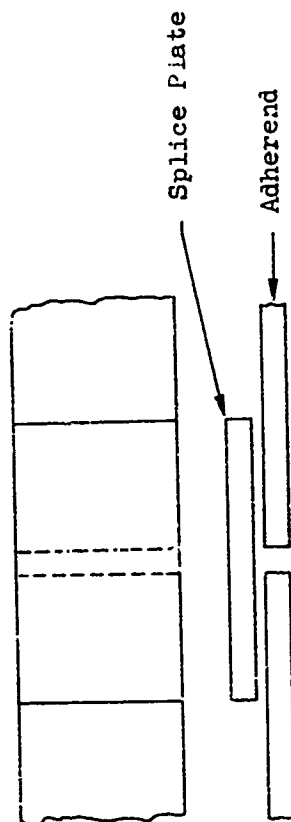
This illustrates the signal reflected from the specimen surface. The signal magnitude, affected by the surface roughness, can be gated to give some measure of energy scattered away from the sound beam.

FIGURE 30 - ULTRASONIC SIGNAL PRESENTATION ON CATHODE RAY TUBE.



This recording was made prior to fatigue testing. The specimen failed on the left side during test. There was a noticeably less amount of sound transmission on the left side which is particularly evident on the third and fourth sensitivity levels from the left. Sensitivity is decreasing from the right.

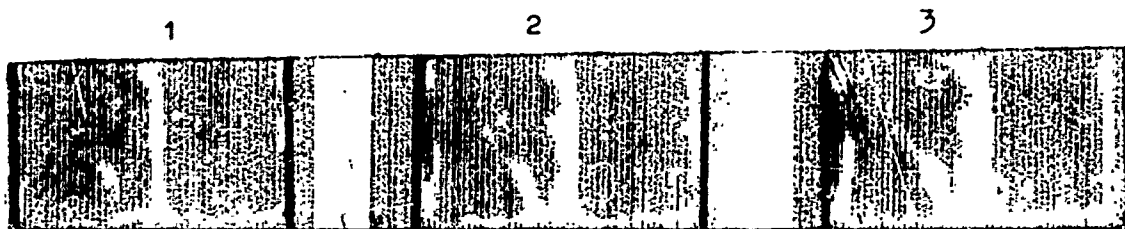
FIGURE 31 C-SCAN RECORDING OF TYPICAL JOINT SPECIMEN



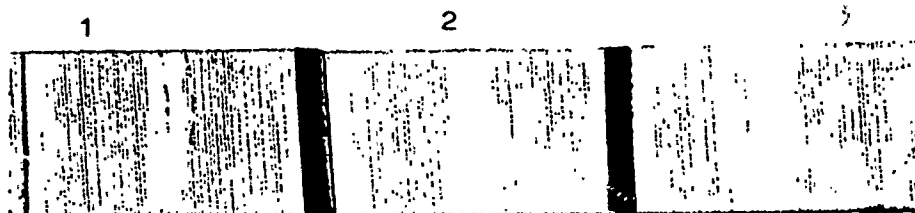
This recording was taken from a group of specimens which were not fatigue tested due to a poor bond. Notice the lack of sound transmission at all sensitivity levels.

FIGURE 32 C-SCAN RECORDING OF POORLY BONDED JOINT

Reproduced from
best available copy.



ULTRASONIC C-SCAN RECORDING
C-scan of Graphite Joint G9A.
Low sound transmission shown
as white area.



ULTRASONIC C-SCAN RECORDING
C-scan of Fiberglass Joint FG7A.
Low sound transmission shown as
white area.

* Gate level above samples denotes sensitivity to low sound transmission areas wherein 1 is least sensitive.

FIGURE 33 C-SCAN RECORDINGS FROM GRAPHITE AND FIBERGLASS
COMPOSITE JOINTS

This problem was eliminated by a close visual inspection which revealed any wide variation in surface roughness among the specimens. However, the visual inspection did not represent an actual measurement. A measurement can be accomplished using the first interface signal (reflection from the part surface) shown in Figure 30. This signal decreased in strength as the surface roughness increased. The surface roughness would not be a factor if the inspection was intended to detect only voids, delaminations or disbonds. It must be considered as a factor however if any future investigations are to be made to determine the strength of a bonded joint.

3.2.1.4 Bondline Thickness - Sound transmission was inversely proportional to bondline thickness. This was noted on some samples wherein the bondline was .001 inch thicker on one side of the joint specimen. At extremely high sensitivity (low energy level) the sound attenuation dropped appreciably in the thick bondline area.

This measurement would be a critical factor in any investigation to determine the strength of a bonded joint. At the high ultrasonic energy levels used in this investigation it was not a significant factor.

3.2.1.5 Summary of Test Results - Only one group of specimens were rejected using the ultrasonic system and these specimens did not undergo fatigue testing. A C-scan representing a typical specimen from this group is compared with a good joint in Figures 31 and 32.

Ultrasonic analysis of the joints gave a better overall evaluation of the specimens than any of the other NDE disciplines. Sufficient data was accumulated to affect the techniques used in the evaluation of bonded joints in future investigations.

C-scans were also made of graphite and fiberglass joint specimens. The recorder was adjusted to print good areas thus high attenuation areas were the light or white areas (Figure 33). A lower energy amplification level was noted on the graphite specimens than that required to obtain similar energy transmission levels for the fiberglass and boron specimens. This would indicate better sound transmission through the graphite specimens. The gain level was adjusted to have comparable C-scans of all specimens.

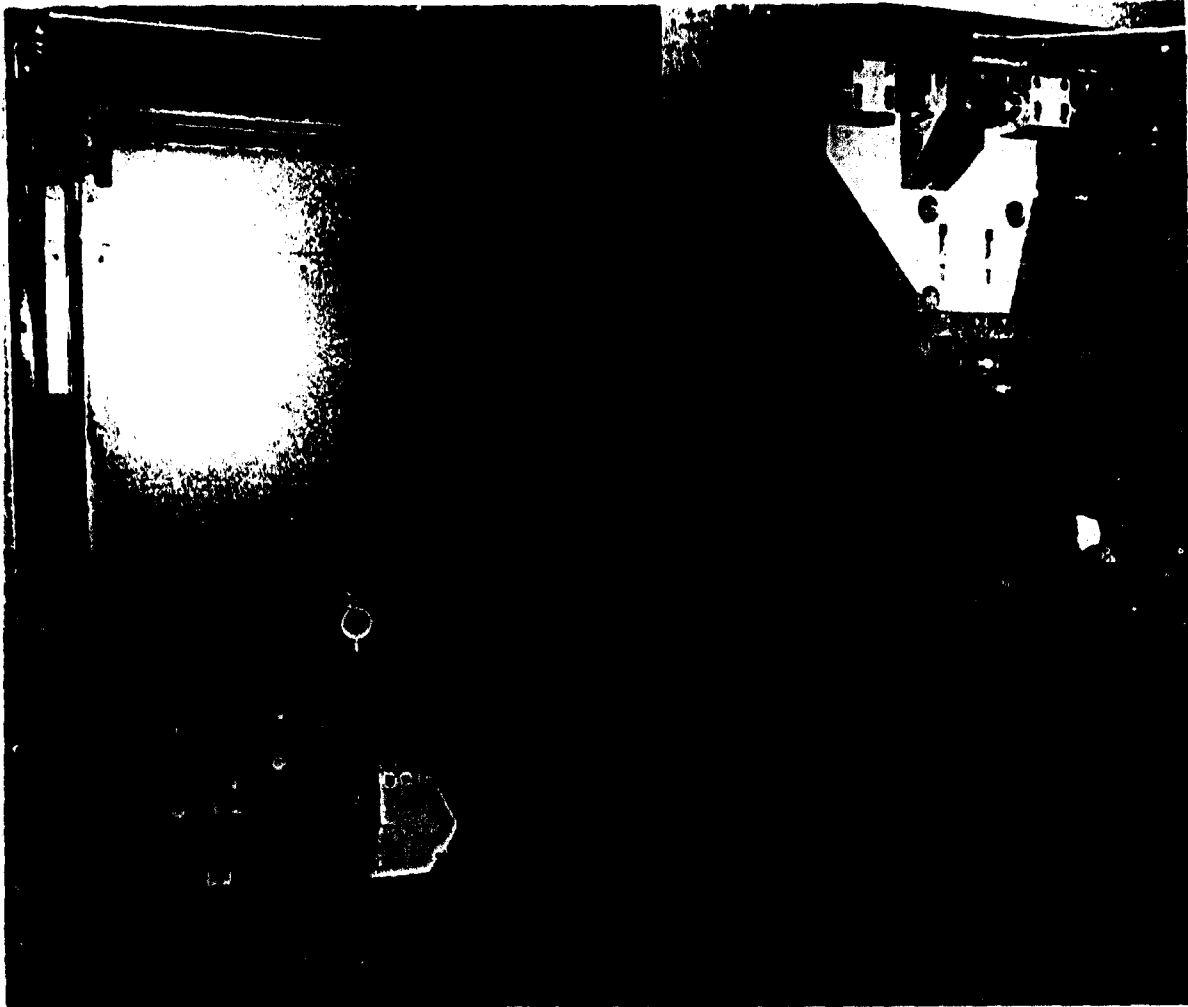
This lower energy level requirements was due in most part to two conditions found in these specimens: first, the thinner bond lines in these specimens which attenuated the sound less and second, the smoother graphite surfaces. The surface roughness was much greater in the boron specimens, which scatters the impinging sound, thereby decreasing the energy received by the transducer. The roughness is attributed to use of a fiberglass peel ply (181 style cloth) and to the large boron filaments which also scatter the sound energy as it travels through the laminate and joint. A comparison between the C-scans for fiberglass and graphite joints having the same bondline thicknesses shows more sound transmission through the graphite than the fiberglass specimens. Again the surface roughness of the fiberglass specimens was greater. A comparison of C-scans of specimens at the extreme ends of the thickness range showed slight differences in sound transmission.

3.2.2 Radiography Inspections

X-rays were made of joint specimens to detect porosity, fiber orientation, foreign material and cracks. Radiography was accomplished with a TORR Laboratories Type TX-360 unit with the following specifications: 0-120 KV, 3 or 5 ma, 0.15 inch Beryllium window and a 0.35 mm focal spot size. The equipment is shown in Figure 34.

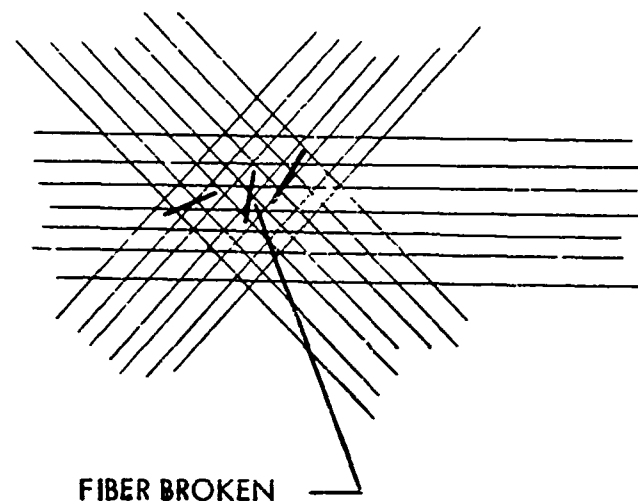
3.2.2.1 Defect Conditions - These conditions illustrated in Figure 35, can generally be defined as or related to:

- o Foreign Material - This is defined as any extraneous matter which does not resemble the surrounding material in structure or form. The image will appear on the radiograph as a less dense (light) sharply defined object.
- o Fiber Spacing - The distance between two adjacent parallel fibers. This distance will generally be approximately 0.004 inches.
- o Fiber Orientation - The direction fibers are running in a ply. An abnormal condition will exist when one or more fibers run unparallel to the normal direction.
- o Fiber Breakage - Small lengths of fibers dispersed throughout the composite.

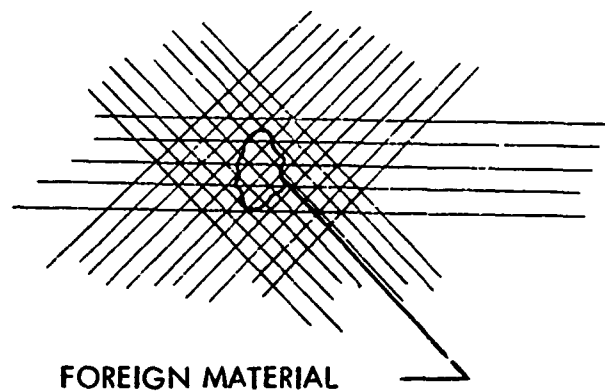


The x-ray source is shown on the right.
The fixture shown on the left is the laminography
specimen plate and film holder. The cabinet is
being utilized for both conventional radiography
and laminography.

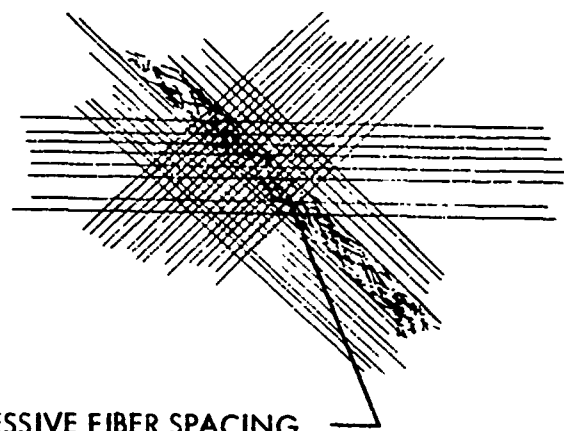
FIGURE 34 - X-RAY SOURCE



FIBER BROKEN



FOREIGN MATERIAL



EXCESSIVE FIBER SPACING

FIGURE 35 DEFECT CONDITIONS IN FILAMENTARY COMPOSITES

3.2.2.2 Summary of Test Results - Radiographs were taken of 713 joint specimens.

No condition severe enough to reject any specimen was detected. However, the preceding conditions were found in many specimens noted as follows:

- o Fiber Breakage - Broken fibers were found in 278 specimens. The fibers were either scattered throughout the joint or concentrated at the edge.
- o Fiber Spacing - Samples in which some fibers exceeded .004 inch spacing between parallel fibers totalled 36.
- o Fiber Orientation - Lack of parallelism was noted among very few fibers in 42 specimens.
- o Foreign Material - This condition was detected in 29 samples.

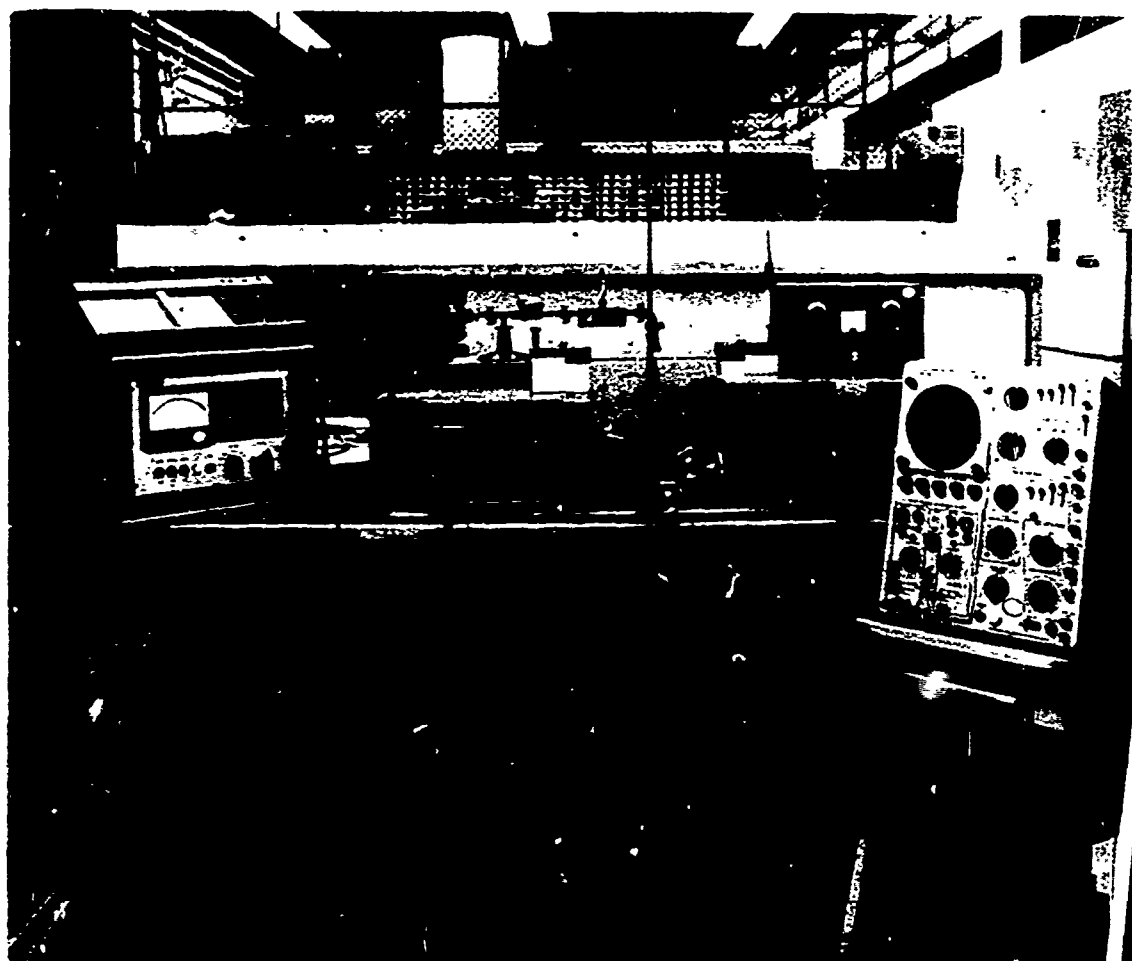
Unknown conditions indicated by abrupt changes in density were noted in 6 specimens. This may be an indication of thin bondline or light porosity.

Some specimens exhibited two of the above conditions. One or more of the defect conditions were detected in 373 of the 713 evaluated specimens. No correlation could be noted between the x-rays and the ultrasonic C-scans.

3.2.3 Microwave Inspections

Microwave testing was accomplished with Microdac Model 664 instrumentation and a Lockheed built Structural Integrity Tester (Figure 36). The tester was a swept frequency square wave generator with a range of 30 Hz to 3.2 kHz. The generator was used in conjunction with a vibrating solenoid to provide a mechanical energy input into the joint specimens. The microwave unit was used to analyze the resultant specimen vibration and determine the resonant frequency. The resonant frequency is a function of the stiffness of the specimen. It was hoped that this would also be a measure of joint quality.

Post fatigue inspection of sixteen joint specimens showed a significant drop in resonance frequency for all specimens tested. This was considered to be significant to warrant further investigation to determine the cause. In so doing it was discovered that the holding



The microwave vibration detector is shown on the left and the swept frequency generator and oscilloscope on the right. The resonant frequency is determined from the scope trace.

FIGURE 36 - MICROWAVE SYSTEM

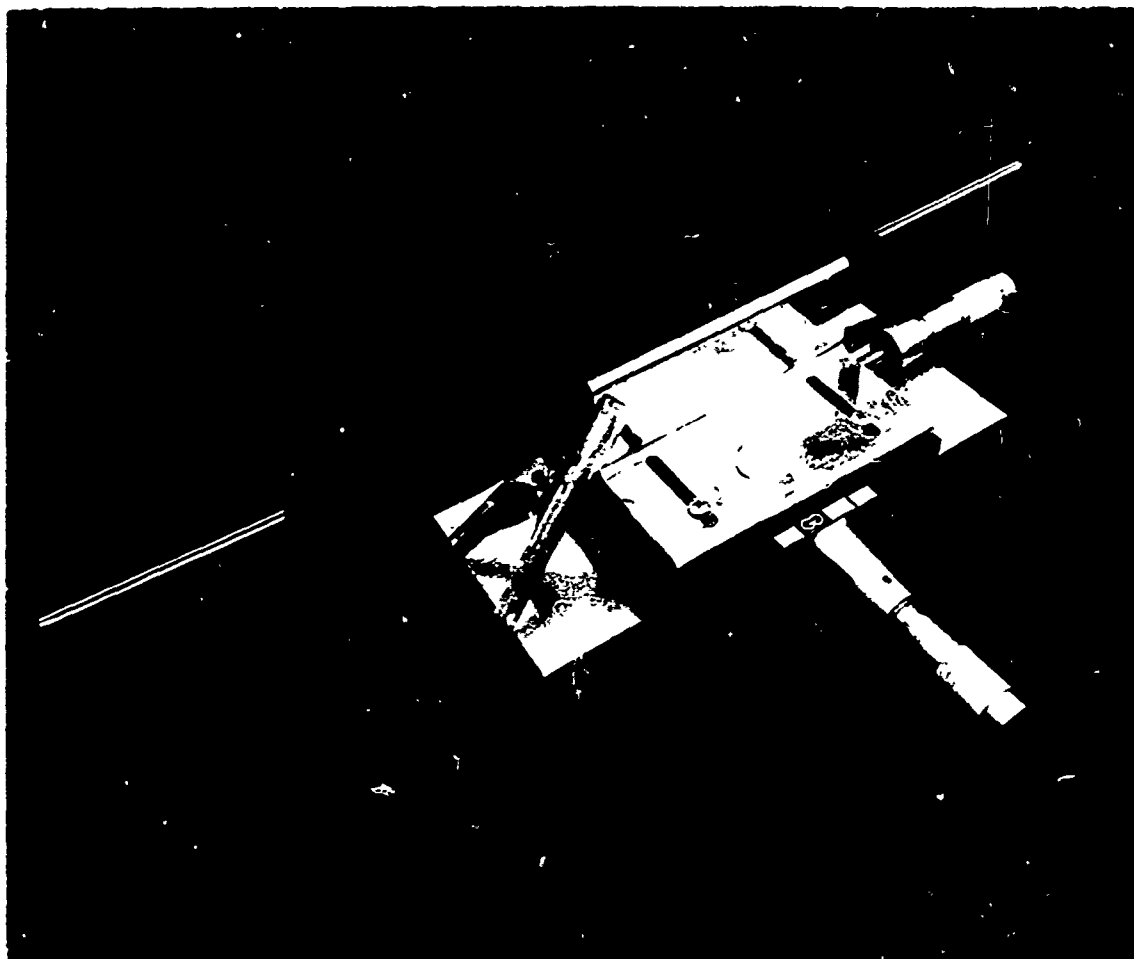
fixture had been changed to improved alignment of the specimens. Since this holding fixture changed between the two data points in the specimen history, the data cannot be directly compared and additional data is not available to verify the effect of the specimen holder on the read-out. Additional research beyond the scope of this investigation would be required.

Microwave resonance has shown promise since tests involving joint specimens with introduced voids yield significant changes in resonance frequency. The range for no voids was 53 to 74 Hz while the range for the same specimens after voids were introduced was 50 to 62. The above overlap would not be apparent if individual specimen readings were considered; i.e., 53 before to 50 after and 72 before to 62 after. This data demonstrated the capability of the microwave system. However, its use is limited since fine line measurements of actual bond quality is not comparable with the capability of current ultrasonic methods.

3.2.4 Visual Inspections: Bondline Measurement

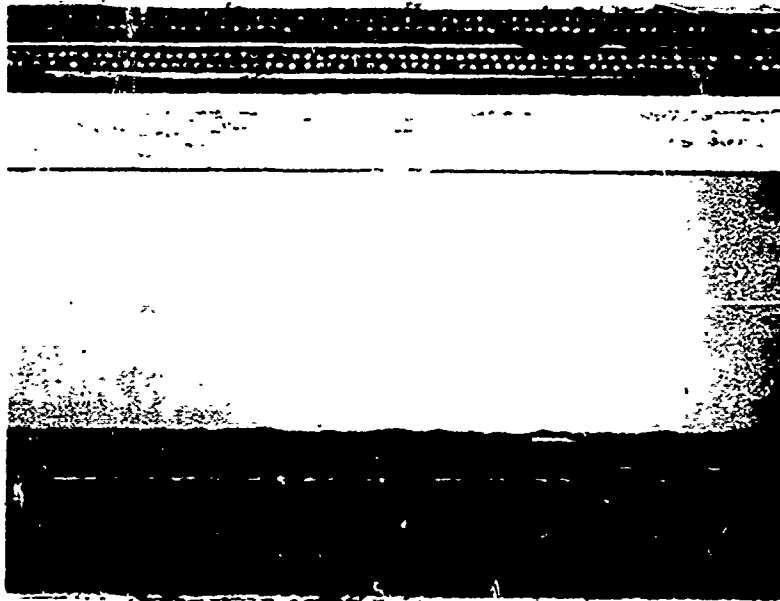
The thickness of a bondline affects the quality or strength of a bonded joint. A device was designed and built to optically measure the thickness of a bondline at the edge of a specimen (Figure 37). Initially, visible light was used to illuminate the bond joint. However, the interface between the adhesive and laminate was not well defined. After the bondline adhesive was found to fluoresce under ultraviolet light, the interface was easily defined for optical measurement (Figure 38). The technique utilized the micro-positioner stage, ultraviolet light and a microscope as in Figure 39.

The bondline thickness measurement was accomplished by positioning a line in the eyepiece of the microscope on one side of the bondline, then turning the micrometer dial of the stage until the line moved to the opposite side of the bondline. The thickness was read directly from the dial with an accuracy of ± 0.0001 inch.



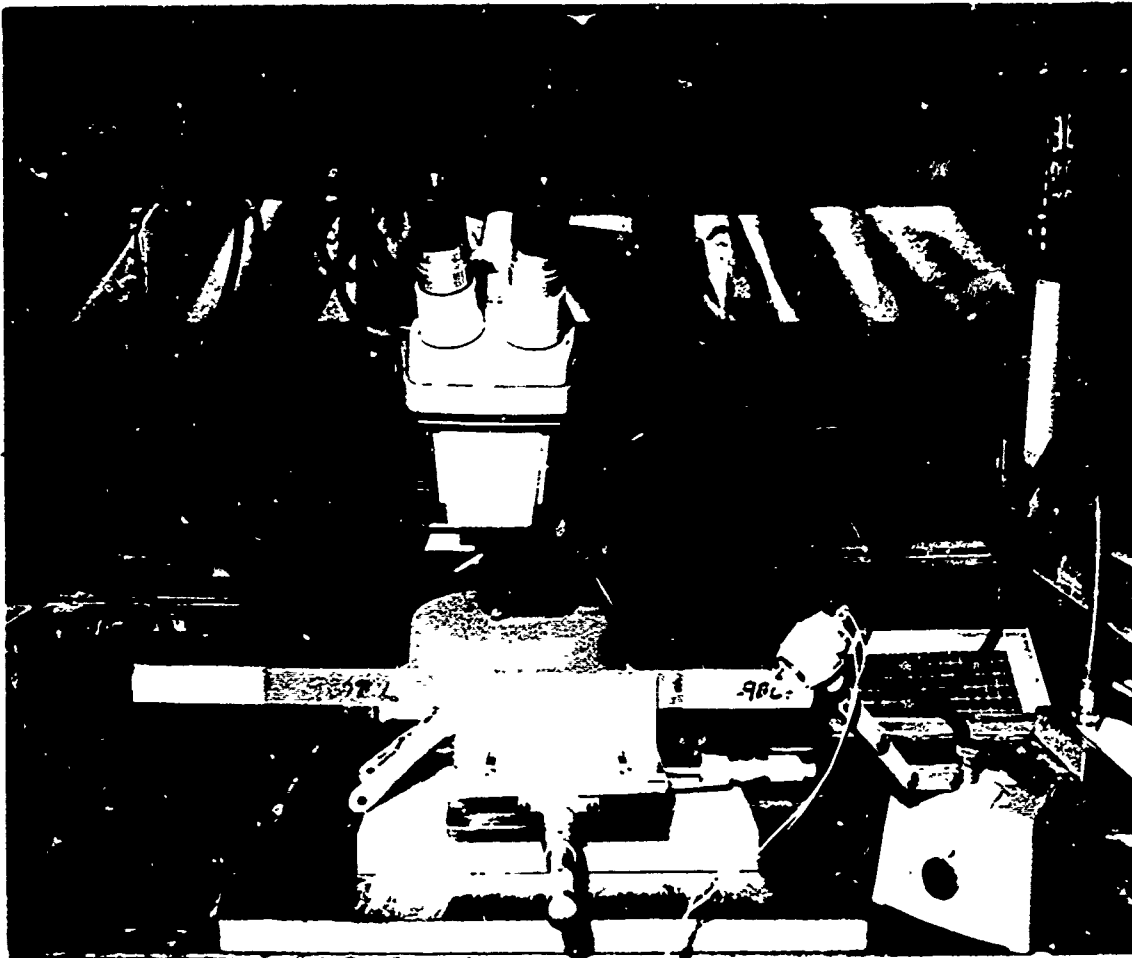
The micropositioner is mounted under the microscope and the bondline thickness reading is made directly from the micrometer dial. The dial is turned until a line in the microscope eyepiece moves from one side of the bondline to the other.

FIGURE 37 - MICROPOSITIONER AND SPECIMEN



These are two typical configurations. One has a titanium splice plate and the other a boron splice plate. Bondline measurements are center of the nearest filament ply. The distance from the center of the filament ply to the edge of the specimen is subtracted from the reading.

FIGURE 38 - JOINT SPECIMENS SHOWING BOND LINES



The joint specimens are mounted on edge and illuminated with ultraviolet light. The bondline fluoresces and becomes easily discernable. The bondline is viewed through the microscope.

FIGURE 39 - BONDLINE MEASURING SYSTEM

Bondline measurements adjacent to boron adherends present a handicap, since the use of a peel ply on the boron laminate causes an irregular interface between the boron and the adhesive. Therefore, when boron adherends are involved, the measurement is taken to the centerline of the first ply of boron. To account for the thickness of laminate included in the measurement, 0.004" is subtracted from the recorded measurement. This correction includes the thickness of the half-ply included in the measurement and the thickness of the surface scrim and resin. When the adherend and splice are both composite, the measurement is taken from centerline to centerline of the first plies of the adherend and splice and then corrected by subtracting 0.008".

Specimens, representative of Configuration B and fabricated by the co-cured process, have also been inspected for bondline thickness by this procedure. During the curing and bonding process, the laminating resin and adhesive resin combine to such a degree that a finite bondline cannot be defined. Therefore, in joints of this type, the distance between the metal adherend and the centerline of the adjacent ply is measured. From this, an effective bondline is determined for use in analysis procedures and data correlation.

3.2.5 NDE Data Analysis and Comparison

Utilization of ultrasonic, radiographic, microwave, and visual inspection methods permitted the establishment of the relative merits of each discipline. As a result the elimination of some disciplines may be possible with the incorporation of other disciplines.

As was stated previously the ultrasonics discipline presented what is believed to be the most useful data. The possibility of expansion or refinement of the technique into a more accurate qualitative evaluation system is most promising. At least two factors which must be resolved or investigated before the refined system could be established are:

- o Rigid control of ultrasonic beam transmitted by the transducers; i.e., energy level, frequency, etc.
- o Development of more accurate calibration system for bondline joints with variance in cross-section; i.e., step joints.

Microwave investigation did not provide sufficient data to prove or disprove the merits of microwave testing. It is recommended that future analysis be made with this system using a finer control of the specimen vibration and that a device which measures the dielectric constant of the bond joint in-process be included in future investigations.

The capability of radiography was proven. However, it may not be necessary in future investigations of this sort. The defects detected were not of sufficient magnitude to warrant rejection by current standards. Therefore, it could be assumed that the joints can be sufficiently evaluated with the other disciplines.

As a result of this investigation the following recommendations for future work are made:

- o Radiography be limited to sampling only.
- o The dielectric constant device be utilized.
- o Ultrasonic testing be expanded to more definitive data.

All measurable variables which do not deteriorate the joint strength should be determined then compensated for in the non-destructive testing evaluation data. Once this is done effective joint quality data analysis can be accomplished.

Microwave investigation did not provide sufficient data to prove or disprove the merits of microwave testing. It is recommended that future analysis be made with this system using a finer control of the specimen vibration and that a device which measures the dielectric constant of the bond joint in-process be included in future investigation.

The capability of radiography was proven. However, it may not be necessary in future investigations of this sort. The defects detected were not of sufficient magnitude to warrant rejection by current standards. Therefore, it could be assumed that the joints can be sufficiently evaluated with the other disciplines.

As a result of this investigation the following recommendations for future work are made:

- o Radiography be limited to sampling only.
- o The dielectric constant device be utilized.
- o Ultrasonic testing be expanded to more definitive data.

All measurable variables which do not deteriorate the joint strength should be determined then compensated for in the non-destructive testing evaluation data. Once this is done effective joint quality data analysis can be accomplished.

3.3 MATERIAL ACQUISITION AND ASSESSMENT

During the course of the program, it was necessary to produce supporting material property data; although, to a great extent, reliance was placed upon composite materials data generated by the Lockheed-Georgia Company during conduct of contractual and in-house developmental programs. Data from related industry programs were also used, where applicable, to reduce the amount of required testing. Sufficient information exists on the composite materials and laminate orientations being used for this program to establish complete and dependable constant-life diagrams for the basic material. Spot check tests were performed on the composite materials used in this program to assure compatibility with available data.

The adherend materials used in this program fall into two general categories: metallic and composite. The basic uniaxial stress-strain data and fatigue properties (S-N curves) were required for all materials in order to provide properties for the analysis methods. These material properties were obtained from statistically significant data so as to remove these variables from the large number of other variables which will be evaluated during the program.

The stress-strain and basic fatigue behavior of the metallic materials were obtained from Military Handbook 5. Additional data, such as the thermal coefficient of expansion, Poisson's Ratio, and shear modules for the metallic materials, were obtained from Military Handbook 5 and Aerospace Structural Metals Handbook.

The basic lamina stress-strain and fatigue behavior of the boron composite materials were obtained primarily from the data being generated on Air Force Contract F33615-5257, "Structural Airframe Application of Advanced Composite Materials", at General Dynamics/Ft. Worth. Static and fatigue specimens were fabricated and tested to assure material quality and compatibility with the General Dynamics data.

Two other composite materials were included in the program evaluation but only to a very limited extent. These were graphite-epoxy and glass-epoxy.

Since these materials were included in consideration of the effects of variations in adherend materials and not to develop basic fatigue phenomena, as with the boron material, a high degree of confidence was not required for these materials. As a result, the level of activity associated with the graphite-epoxy and glass-epoxy materials are significantly less.

3.3.1 Acquisition of Tape Materials

Each of the composite material systems was purchased in the B-staged, prepreg tape form. Pertinent information related to materials and their acquisitions are given below.

Boron filaments were produced by Hamilton Standard and furnished to the prepreg company by the Air Force for use in connection with this program. The initial deliveries of tape material, through October 1970, were produced by Narmco Materials Division of Whittaker Corporation. Subsequent deliveries were made by Avco Systems Division, Avco Corporation. All boron tape material consisted of the same resin system and was supplied to the same material specification, FMS 2001A dated 21 April 1967. The delivery of boron tape material, quantities and identification are as shown below:

<u>Feet of Tape Delivered</u>	<u>Receipt Date</u>	<u>Batch/Roll Nos.</u>
1050	2 April 1970	381/74, 75, 76
1950	9 July 1970	392/89 thru 94
193	2 Oct 1970	385/6
1440	2 Oct 1970	408/35, 38, 39, 40
1450	13 Jan 1971	42/1, 2, 3, 4
600	20 Jan 1971	42/5, 6

The concluding material required for evaluation under the contract was a small quantity each of unidirectional fiberglass/epoxy and unidirectional graphite/epoxy. The total amount required was approximately 20 square feet of material. The fiberglass selected for this phase of the investigation was 3M Company's SP 1002 S glass (Batch L19, Roll W329) and the graphite material was Fiberit 1311B (Lot No. 1088, Roll No. 1).

3.3.2 Acceptance and Process Control Assessment

Material acceptance and in-process material evaluation specimens are tested in accordance with standard Lockheed-Georgia quality control specimen configurations and test procedures for composite materials. These methods are compatible with procedures used throughout the industry and include flexure and short beam shear evaluations of 15 ply unidirectional panels.

Fabrication details of all quality control and material acceptance panels and laminates for joints adherends are included in Appendix A, Table A1 - Composite Panel Identification, which provides a cross reference for these panels. In summary a listing of quality control panel numbers, material acceptance panel numbers, material batch numbers, and data usage is defined in Table II.

3.3.2.1 Boron Epoxy - A summary of results obtained from both the acceptance and process control testing and the standards to which the results were compared are presented in Table III, on the basis of batch numbers. The data averages in each instance includes all the different specimens and panels which were evaluated from the specified batch. Other pertinent information related to the quality of the materials of each batch is discussed below.

Batch 381: The observed failures which occurred on the initial longitudinal flexure specimens, Nos. 54949-1 and -2, had a very unusual appearance in that, rather than the clean, regular breaks normally associated with longitudinal flexure tests, the specimens exhibit extensive delaminations extending from the break as much as one-fourth of the distance to the ends of the test specimen. For this reason an additional panel No. 56136, was fabricated and tested for 0° flexure strength and based on the results of these two panels batch 381 was considered acceptable. Batch 381 continued to exhibit good quality through the test results obtained subsequently.

TABLE II

BORON-EPOXY ACCEPTANCE AND CONTROL PANEL JUSTIFICATION

<u>Panel or Q. C. Number</u>	<u>Material Batch No.</u>	<u>Data Usage</u>
54959	381	Material Acceptance
56136	381	Recheck Material Acceptance
56591	381	Q. C. Check on Material Verification
57836	381	Q. C. Check on Joint Panel
58392	381	Q. C. Check on Joint Panel
59038	392	Material Acceptance
59579	392	Material Acceptance
59813	381	Q. C. Check on Joint Panel
60365	381	Q. C. Check on Joint Panel
60581	392	Q. C. Check on Joint Panel
61039	392	Q. C. Check on Joint Panel
61198	392	Q. C. Check on Joint Panel
61588	392	Q. C. Check on Joint Panel
61873	408	Material Acceptance and Q. C. Check on Joint Panel
62844	385	Material Acceptance and Q. C. Check
63195	408	Q. C. Check on Joint Panel
63652	408	Q. C. Check on Joint Panel
64078	408	Q. C. Check on Joint Panel
64382	408	Q. C. Check on Joint Panel
64845	42	Material Acceptance
65418	42	Q. C. Check on Joint Panel
65745	42	Q. C. Check on Joint Panel
66858	42	Q. C. Check on Joint Panel
67326	408	Q. C. Check on Joint Panel
69552	43/3	Q. C. Check on Joint Panel
70085	43/6	Q. C. Check on Joint Panel
70085	45/11	Material Acceptance

TABLE 41

Material Batch No.	Acceptance Standard	Longitudinal Flexure	Transverse Flexure	Horizontal Shear	Tensile Coupon	
					[0, 90, 0, 90] _s	[0, 0, 90, 0] _s
381		225	13.0	13.0	90	
	Avg.	247	14.3	14.6		
	Max.	268	16.2	15.3		
	Min.	237	12.7	13.6		
	Tests	23	17	18		
392		247	12.7	13.7		
	Avg.	268	15.1	14.9		
	Max.	235	10.8	12.0		
	Min.	21	21	21		
	Tests					
385		259	12.8	14.0		
	Avg.	268	13.6	14.1		
	Max.	247	12.2	13.8		
	Min.	3	3	3		
	Tests					
408		260	11.8	13.6	85.6	138
	Avg.	281	13.3	15.4	94.0	141
	Max.	231	9.6	10.6	73.2	136
	Min.	24	24	24	5	3
	Tests					
42		264	12.5	14.9		
	Avg.	282	13.9	15.4		
	Max.	233	11.4	13.7		
	Min.	21	21	21		
	Tests					

TAPC (Continued)

Material Batch No.		Longitudinal Flexure	Transvers Flexure	Horizontal Shear	Tensile Coupon	
					[0, 90, 0, 90] _s	[0, ±45, 0] _s
43	Avg.	268	13.0	14.6		
	Max.	285	14.7	15.1		
	Min.	253	11.3	13.9		
	Tests	6	6	6		
45	Avg.	278	15.6	15.8		
	Max.	280	16.3	16.0		
	Min.	275	15.2	15.6		
	Tests	3	3	3		

Batch 392: The initial results for Batch 392 were slightly below standard, panels 59038 and 59579, but tensile coupons having $0^\circ/\pm 45^\circ$ fiber orientation and fabricated at the same time developed 100 ksi indicating material acceptable for joint fabrication. Subsequent Q.C. tests have shown improved values for this material with the exception of transversed flexure which frequently are below standard. Control specimens of all bonded joint panels were evaluated for static strength prior to specimens being fatigue tested, as a conditional requirement for accepting this batch of material.

Batch 385: This batch consisted of a single roll of material and represented a partial shipment with Batch 408. The data representing the quality of this material also indicated a low transverse flexure strength.

Batch 408: This batch was the last lot of material supplied by Narmco. Transverse flexure strengths continued to be below requirements although the horizontal shear and 0° flexure strengths were adequate for most specimens tested. The most severe variations observed for the program were detected in two panels of Batch 408 in which the transverse flexure values averaged 9.9 and 10.4 KSI. For the most part, however, the below-standard values have been near or above 12 KSI. Again, as a precaution all bonded joint panels were evaluated for static strength prior to evaluating specimens for fatigue capability. Specimens which exhibited low laminate properties were rejected and replacement specimen fabricated. Due to the very low initial results, No. 61873, additional tensile coupon tests were also performed on $0^\circ/90^\circ$ and $0^\circ/\pm 45^\circ$ panels in conjunction with the standard Q. C. flexure specimens. Although the transverse flexure results were slightly below specification requirements (13 ksi), these laminates were used for joint specimen fabrication based on the acceptable results obtained from the tensile coupons.

Panels represented by Q.C. specimen numbers 64382 were rejected for use in the lap joint specimens. However, one panel was used for fabrication of the Configuration C specimens (Appendix C) based on acceptable tensile strength of these specimens.

Batch 42: Initial tests on Batch 42, the first batch supplied by Avco, show that it is approximately equal in quality to the material received from Narmco. It should be

noted that the transverse flexure strength is marginal as it was for the last batch received from Narmco, Batch 408.

Batch 45: The test results for these panels are, for the most part, consistent with previous determinations of a similar nature. An exception is noted for Batch 45, roll 11 which exhibited significantly higher transverse flexure and horizontal shear strengths than for other batches of material evaluated under this program.

3.3.2.2 Graphite Epoxy and Glass Epoxy - Due to the small amount of laminate material required for the fiberglass and graphite bonded joint specimens, the unidirectional 15-ply quality control laminates fabricated concurrent with the joint laminates also served for acceptance of the respective materials. Test results obtained from these specimens were acceptable, and were comparable to values obtained by other investigators. Tabulated results for these materials are listed in Table IV.

3.3.3 Material Properties Verification

To take advantage of the material properties data available from outside sources, it was first necessary to verify that the materials being received were of the same quality. A comparison was made between the verification tests recorded in Appendix B and data published in AFML-TR-69-101, Volumes IV and V, "Structural Airframe Application of Advanced Composite Materials". This was done with static and fatigue properties for $(0, 90, 0, 90)_s$ and $(0, \pm 45, 0)_s$ laminates and the results are summarized in Appendix B1 for the individual static and fatigue property tests and in Figure 40 for the fatigue characteristics. The materials were judged to be sufficiently consistent for accepting the data base. The greatest variance is observed for the $0^\circ/\pm 45^\circ$ fatigue testing at $R = -1.0$. This difference can be explained by the dissimilarity of cyclic rates during test, i.e., the General Dynamics data was developed at 1800 Hz and the Lockheed tests were made at 900 Hz. Another discrepancy is noted in the 0-90 tensile requirements but this difference was attributed to the fact that the requirement is set for sandwich beam tests which generally gives higher values than coupons.

TABLE IV
RESULTS OF CONTROL TESTING FOR
GRAPHITE-EPOXY AND GLASS-EPOXY LAMINATES

<u>Specimen No.</u>	<u>Longitudinal Flexure Strength (KSI)</u>	<u>Horizontal Shear Strength (KSI)</u>	
74169-1	187.5	14.4	Fiberglass
-2	170.3	14.0	
-3	170.9	14.1	
Average	176.2	14.2	
74169-4	156.8	11.4	Graphite
-5	162.0	11.3	
-6	155.3	11.1	
Average	158.0	11.3	

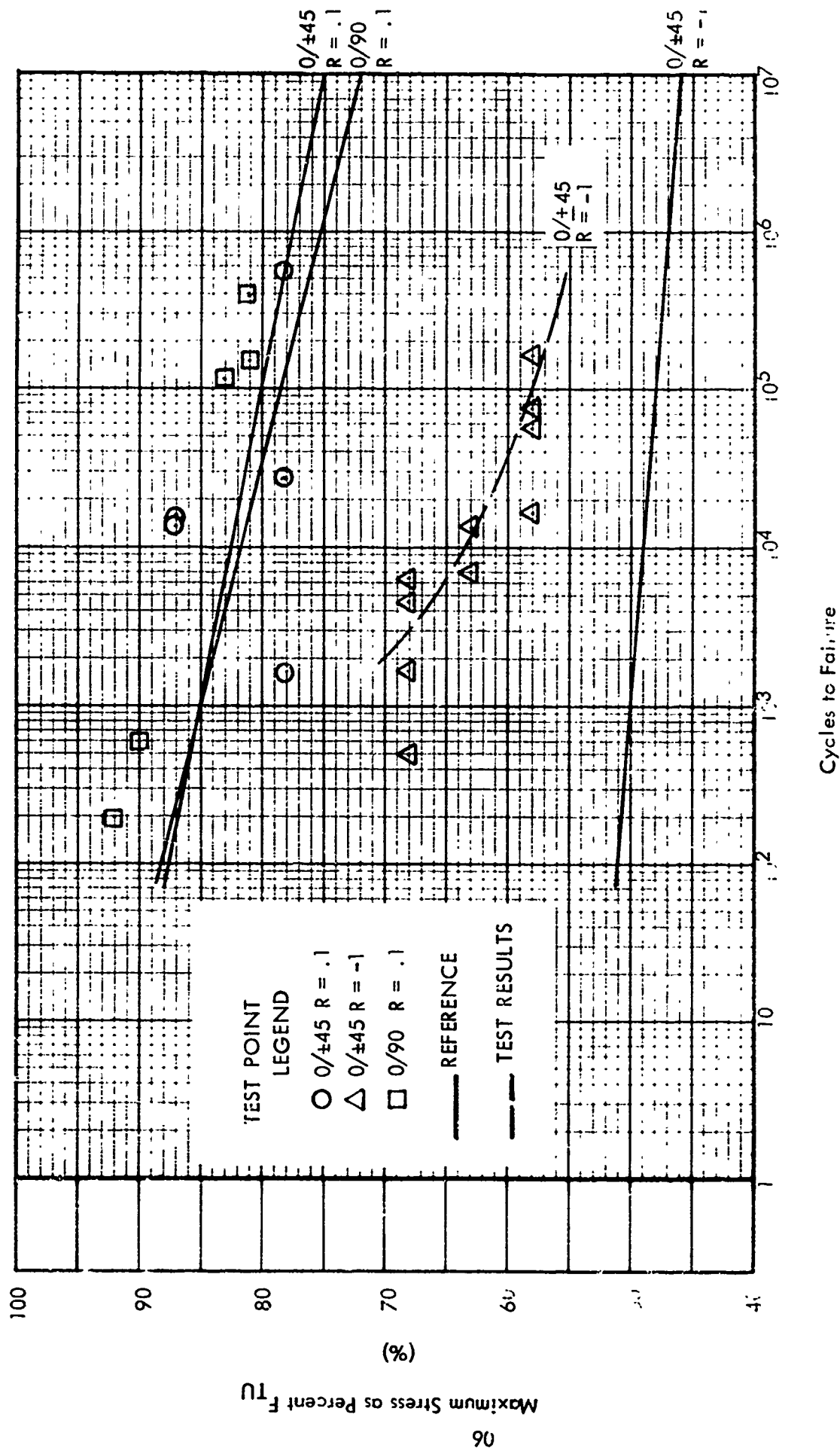


FIGURE 40 COMPARISON OF FATIGUE DATA FOR MATERIAL VERIFICATION

SECTION IV TEST PROGRAM

4.1 GENERAL

The primary objectives of the test program were to develop improved methods for conducting fatigue design and testing of composite structural joints. Both bonded and mechanical joints were evaluated. Bonded and mechanical joint materials consisted of boron-epoxy, 7075-T6 aluminum, 6Al-4V titanium, graphite-epoxy and fiberglass-epoxy. The test specimens consisted of composite-to-composite and composite-to-metal joints fabricated by both adhesive bonding and mechanical fastener techniques. A variety of joint designs were selected and were representative of joints that would be commonly used in aircraft structures. Specimen testing was accomplished in three main phases which were related to specimen size as follows.

Phase I - Small scale laboratory joint specimens, one-inch wide. These specimens constituted the major portion of the test program.

Phase II - Medium scale joint specimens, two inches and three inches wide.

Phase III - Large scale joint specimens, ten inches wide. Only bonded joint specimens were tested in this phase of the test program.

The complete test program is outlined in Tables V thru X. Detailed test results and specimen parameters are included in tabulated form in Appendix B. Detail drawings of all specimens are included in Appendix C. All the unbalanced specimens were supported during static and fatigue testing in order to provide more consistent and representative test data.

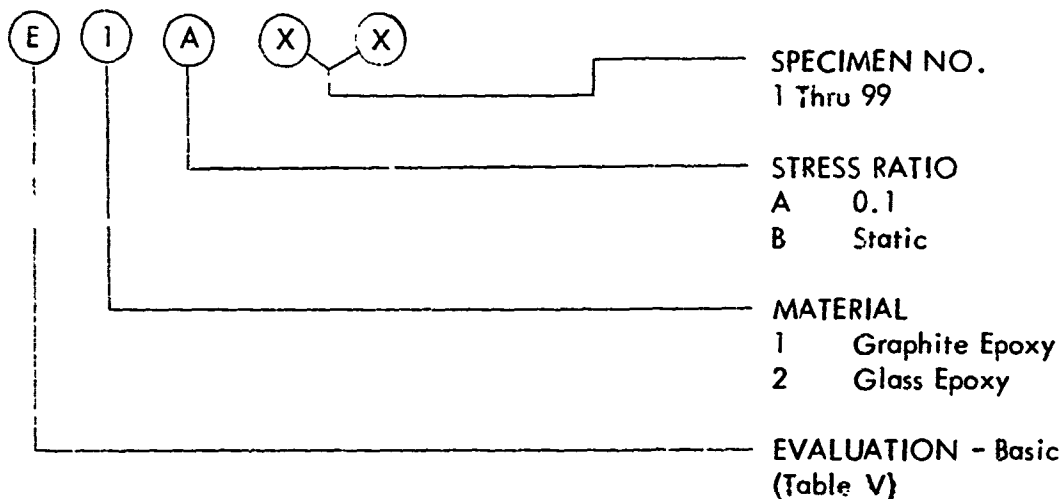
TABLE V

ALTERNATE ADHEREND MATERIALS EVALUATION
GRAPHITE EPOXY AND GLASS EPOXY COMPOSITES

COMPOSITE MATERIAL	JOINT CONFIGURATION	FATIGUE TESTS AT R = 0.1	STATIC CONTROLS
Graphite Epoxy	"A"	10	3
Glass Epoxy	"A"	11	3
TOTALS		21	6

SPECIMEN IDENTIFICATION

EVALUATION - ALTERNATE ADHERENT MATERIALS



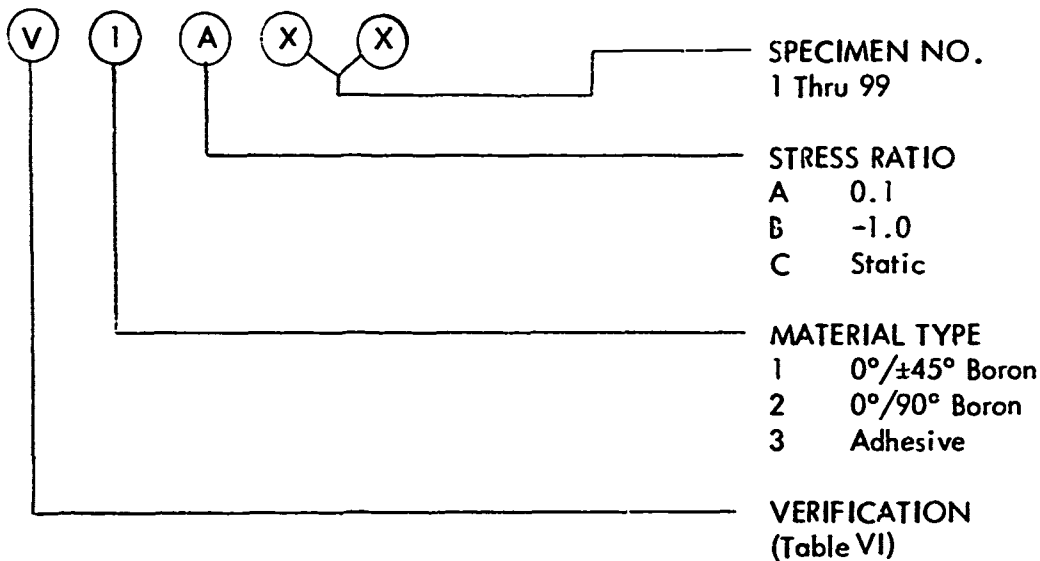
Specimen E1B01 identifies the number one static test specimen for basic evaluation of graphite epoxy.

TABLE VI

MATERIAL VERIFICATION AND CHECKOUT TESTS

MATERIAL		FATIGUE TESTS		STATIC CONTROLS
TYPE	SPECIMEN	R = 0.1	R = -1.0	TENSILE STRENGTH
0°/±45° N 5505	Coupon	5	10	3
0°/90° N 5505	Coupon	5		3
Program Adhesives	Single Lap Joint	15		5
TOTALS		25	10	11

SPECIMEN IDENTIFICATION
VERIFICATION OF MATERIALS



Specimen V1B04 identifies the number 4 fatigue specimen to be tested at a stress ratio of $R = -1.0$ for verification of material strength for a 0°/±45° boron laminate.

TABLE VII

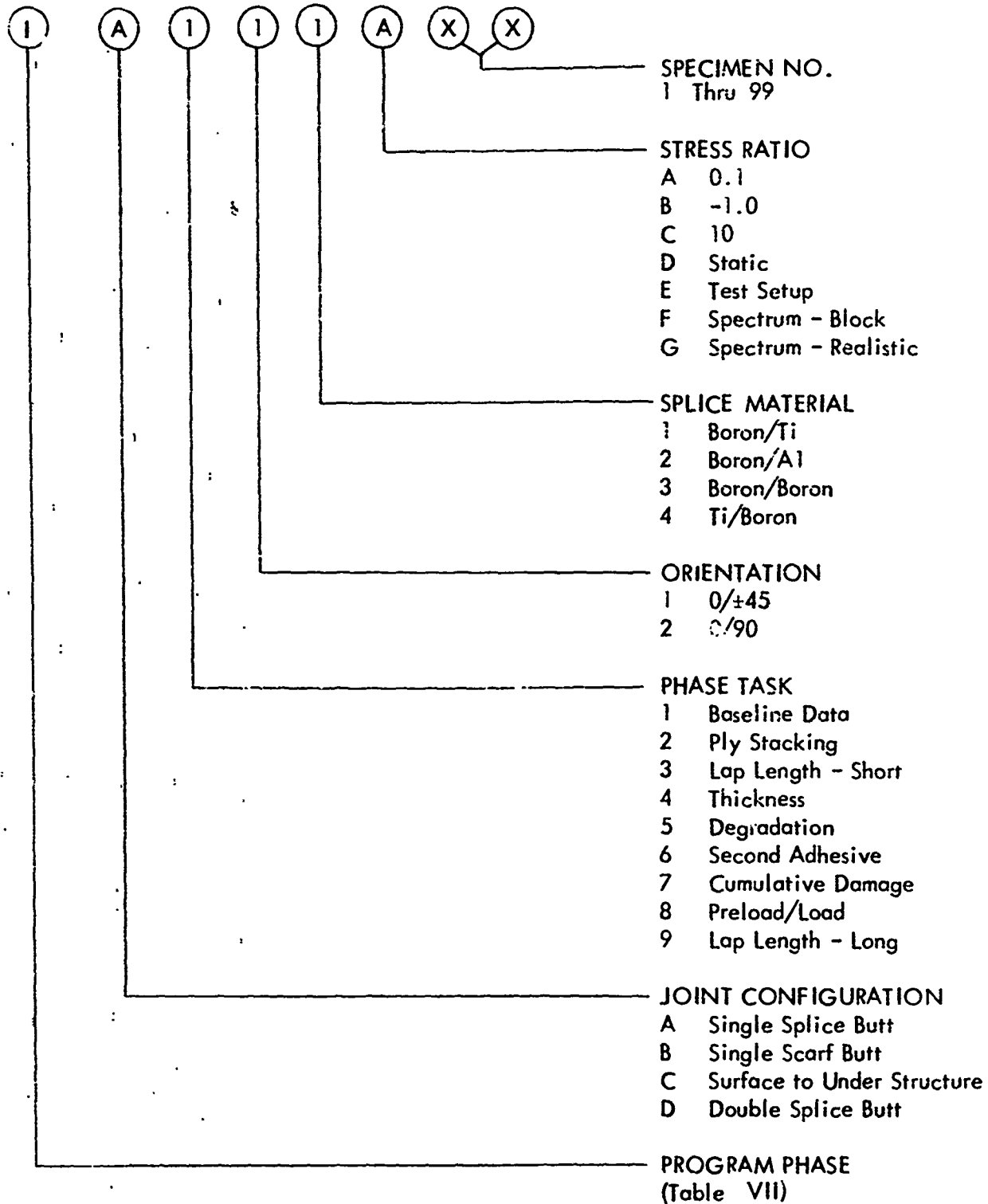
BONDED JOINTS EVALUATION

PHASE I - SMALL SCALE SPECIMENS

JOINT CONFIGURATION ADHEREND COMBINATIONS LOADING STRESS RATIO PROGRAM TASKS BASELINE DATA	"A"		"B"		"C"		"D"		TOTALS
	Boron/Ti: -1.0	(ST)	Boron/Boron 0.1	(ST)	Boron/Al 0.1	(ST)	Boron/Ti 0.1	(ST)	
22 22 26	22	26	14	(14)	10	(10)	10	(10)	155
0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	30
22 22 26	22	26	14	(14)	10	(10)	10	(10)	41
0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	9
2. 0°/90°, Std.	2. 0°/90°, Std.	2. 0°/90°, Std.	2. 0°/90°, Std.	2. 0°/90°, Std.	2. 0°/90°, Std.	2. 0°/90°, Std.	2. 0°/90°, Std.	2. 0°/90°, Std.	12
PLY STACKING EFFECTS	PLY STACKING EFFECTS	PLY STACKING EFFECTS	PLY STACKING EFFECTS	PLY STACKING EFFECTS	PLY STACKING EFFECTS	PLY STACKING EFFECTS	PLY STACKING EFFECTS	PLY STACKING EFFECTS	30
1. ±45°/0°, Std	1. ±45°/0°, Std	1. ±45°/0°, Std	1. ±45°/0°, Std	1. ±45°/0°, Std	1. ±45°/0°, Std	1. ±45°/0°, Std	1. ±45°/0°, Std	1. ±45°/0°, Std	12
LAP LENGTH EFFECTS	LAP LENGTH EFFECTS	LAP LENGTH EFFECTS	LAP LENGTH EFFECTS	LAP LENGTH EFFECTS	LAP LENGTH EFFECTS	LAP LENGTH EFFECTS	LAP LENGTH EFFECTS	LAP LENGTH EFFECTS	32
0°/±45°, Short Lap	0°/±45°, Short Lap	0°/±45°, Short Lap	0°/±45°, Short Lap	0°/±45°, Short Lap	0°/±45°, Short Lap	0°/±45°, Short Lap	0°/±45°, Short Lap	0°/±45°, Short Lap	13
2 0°/±45°, Long Lap	2 0°/±45°, Long Lap	2 0°/±45°, Long Lap	2 0°/±45°, Long Lap	2 0°/±45°, Long Lap	2 0°/±45°, Long Lap	2 0°/±45°, Long Lap	2 0°/±45°, Long Lap	2 0°/±45°, Long Lap	22
THICKNESS EFFECTS	THICKNESS EFFECTS	THICKNESS EFFECTS	THICKNESS EFFECTS	THICKNESS EFFECTS	THICKNESS EFFECTS	THICKNESS EFFECTS	THICKNESS EFFECTS	THICKNESS EFFECTS	9
1 0°/±45°, Added Plies	1 0°/±45°, Added Plies	1 0°/±45°, Added Plies	1 0°/±45°, Added Plies	1 0°/±45°, Added Plies	1 0°/±45°, Added Plies	1 0°/±45°, Added Plies	1 0°/±45°, Added Plies	1 0°/±45°, Added Plies	10
2 0°/90°, Added Plies	2 0°/90°, Added Plies	2 0°/90°, Added Plies	2 0°/90°, Added Plies	2 0°/90°, Added Plies	2 0°/90°, Added Plies	2 0°/90°, Added Plies	2 0°/90°, Added Plies	2 0°/90°, Added Plies	3
DEGRADATION OF JOINT, 0°/±45°, Std	DEGRADATION OF JOINT, 0°/±45°, Std	DEGRADATION OF JOINT, 0°/±45°, Std	DEGRADATION OF JOINT, 0°/±45°, Std	DEGRADATION OF JOINT, 0°/±45°, Std	DEGRADATION OF JOINT, 0°/±45°, Std	DEGRADATION OF JOINT, 0°/±45°, Std	DEGRADATION OF JOINT, 0°/±45°, Std	DEGRADATION OF JOINT, 0°/±45°, Std	10
19 12	19	12	10	(9)	10	(10)	10	(10)	41
Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	Not Done	10
SECOND ADHESIVE	SECOND ADHESIVE	SECOND ADHESIVE	SECOND ADHESIVE	SECOND ADHESIVE	SECOND ADHESIVE	SECOND ADHESIVE	SECOND ADHESIVE	SECOND ADHESIVE	6
CUMULATIVE DAMAGE STUDY	CUMULATIVE DAMAGE STUDY	CUMULATIVE DAMAGE STUDY	CUMULATIVE DAMAGE STUDY	CUMULATIVE DAMAGE STUDY	CUMULATIVE DAMAGE STUDY	CUMULATIVE DAMAGE STUDY	CUMULATIVE DAMAGE STUDY	CUMULATIVE DAMAGE STUDY	10
0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	0°/±45°, Std.	11
1 Realistic Load Spectrum	1 Realistic Load Spectrum	1 Realistic Load Spectrum	1 Realistic Load Spectrum	1 Realistic Load Spectrum	1 Realistic Load Spectrum	1 Realistic Load Spectrum	1 Realistic Load Spectrum	1 Realistic Load Spectrum	14
2 Block Load Spectrum	2 Block Load Spectrum	2 Block Load Spectrum	2 Block Load Spectrum	2 Block Load Spectrum	2 Block Load Spectrum	2 Block Load Spectrum	2 Block Load Spectrum	2 Block Load Spectrum	375
PRELOAD/LOW CYCLE	PRELOAD/LOW CYCLE	PRELOAD/LOW CYCLE	PRELOAD/LOW CYCLE	PRELOAD/LOW CYCLE	PRELOAD/LOW CYCLE	PRELOAD/LOW CYCLE	PRELOAD/LOW CYCLE	PRELOAD/LOW CYCLE	109
0°/±45°, Std	0°/±45°, Std	0°/±45°, Std	0°/±45°, Std	0°/±45°, Std	0°/±45°, Std	0°/±45°, Std	0°/±45°, Std	0°/±45°, Std	
14	14	14	14	14	14	14	14	14	
TOTALS	TOTALS	TOTALS	TOTALS	TOTALS	TOTALS	TOTALS	TOTALS	TOTALS	

TABLE VII (CONTINUED)

SPECIMEN IDENTIFICATION
BONDED JOINTS - PHASE I



Specimen number IB121A08 identifies a specimen for Phase I with a single scarf butt configuration for generating base line data on 0°/90° specimen joined to titanium and tested at a stress ratio of $R = +0.1$. The specimen number within this set is number 8.

TABLE VIII

BONDED JOINTS EVALUATION
PHASE II - MEDIUM SCALE SPECIMENS

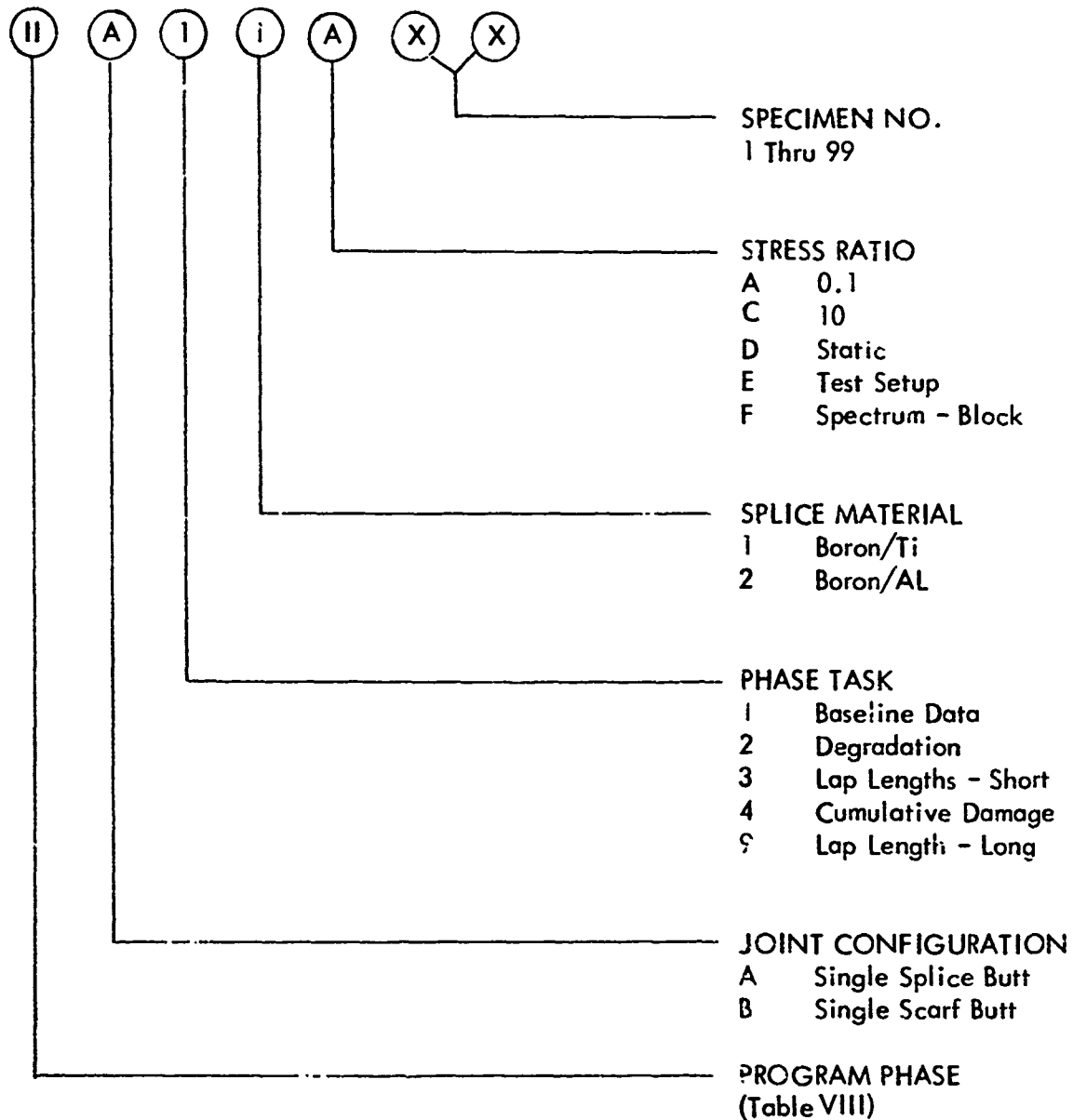
JOINT CONFIGURATION	"A"			"B"			TOTALS
ADHEREND COMBINATIONS	Boron/Ti (Al*)			Boron/Ti			
LOADING STRESS RATIO	0.1	10	(ST)	0.1	10	(ST)	
PROGRAM TASK	NUMBER OF SPECIMENS						FAT. (ST)
BASELINE DATA	15*	5	10**	10*	6	7**	36 (17)
DEGRADATION OF JOINT PROPERTIES	10*						10
LAP LENGTH EFFECTS 1. Short Lap 2. Long Lap							
	5	5	(6)	5	(3)		5 (3) 10 (6)
CUMULATIVE DAMAGE EVALUATION FOR BLOCK SPECTRUM LOADING	[5]						5
TOTALS							66 26

* Five (5) specimens from each of the indicated groups are to have boron composite - aluminum adherends.

** Three (3) specimens aluminum.

TABLE VIII (CONTINUED)

SPECIMEN IDENTIFICATION
BONDED JOINTS - PHASE II



Specimen number IIA32C02 identifies a specimen for Phase II with a single splice butt configuration for evaluation of overlap length with aluminum splice adherend tested as a stress ratio of $R = +10$. The specimen number within this set is number 2.

TABLE IX

BONDED JOINTS EVALUATION
PHASE III - LARGE SCALE SPECIMENS

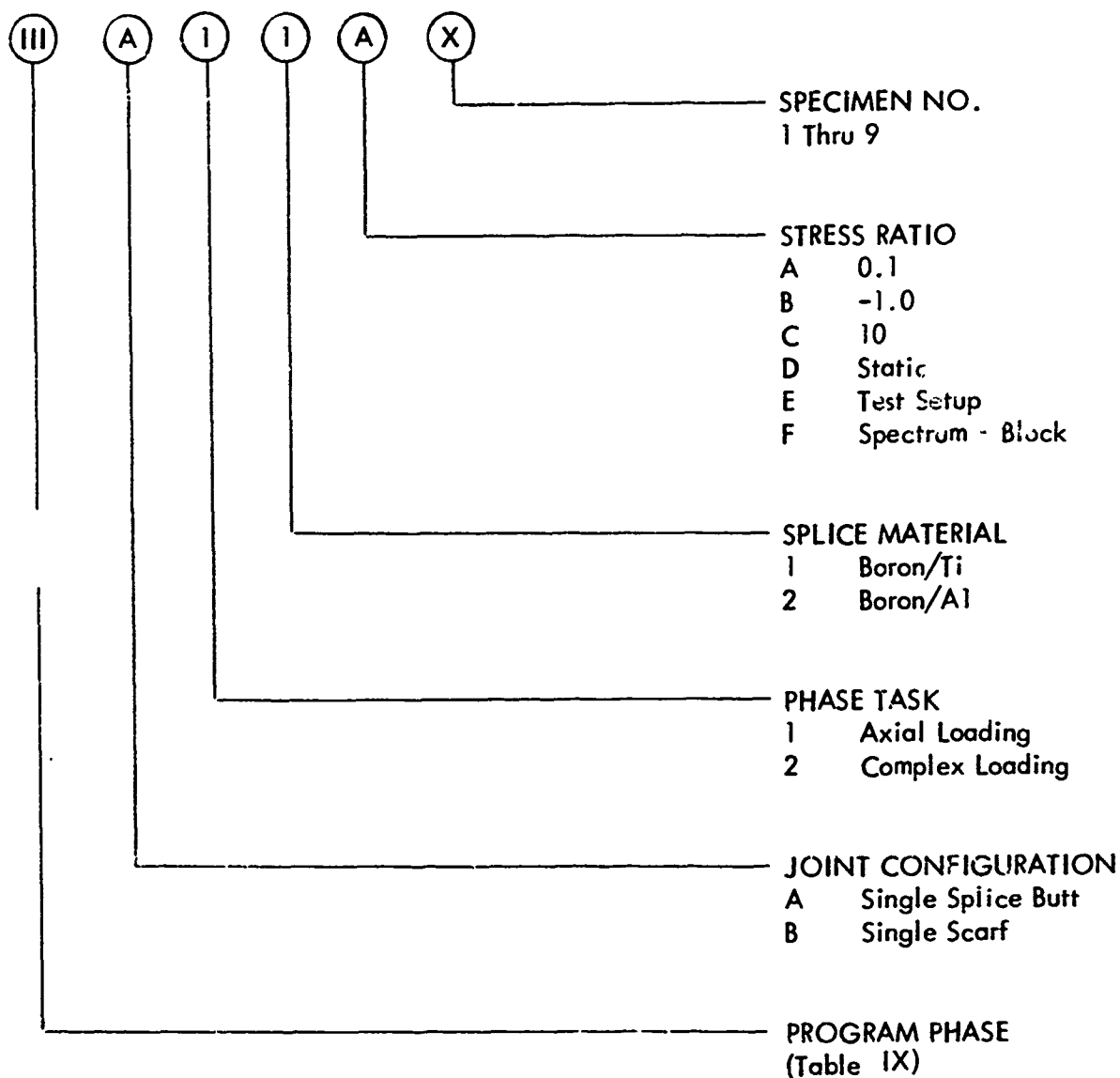
JOINT TYPE	"A"				"B"			TOTALS	
ADHERENDS	Boron/Ti (Al*)				Boron/Ti				
STRESS RATIO	0.1	-1.0	10	(ST)	0.1	-1.0	(ST)	FAT.	(ST.)
PROGRAM TASK	NUMBER OF SPECIMENS								
AXIAL LOADING FOR LARGE JOINTS	2*	2*	1	(2*) 8**	1	1	(3**)	7	13
COMPLEX LOAD EVALUATION FOR BLOCK SPECTRUM CYCLING	[1]				[1]			2	
	TOTALS							9	13

* One (1) specimen of each group indicated is to have boron composite
- aluminum adherends.

** 1" wide static specimens.

TABLE IX (CONTINUED)

SPECIMEN IDENTIFICATION
BONDED JOINTS - PHASE III



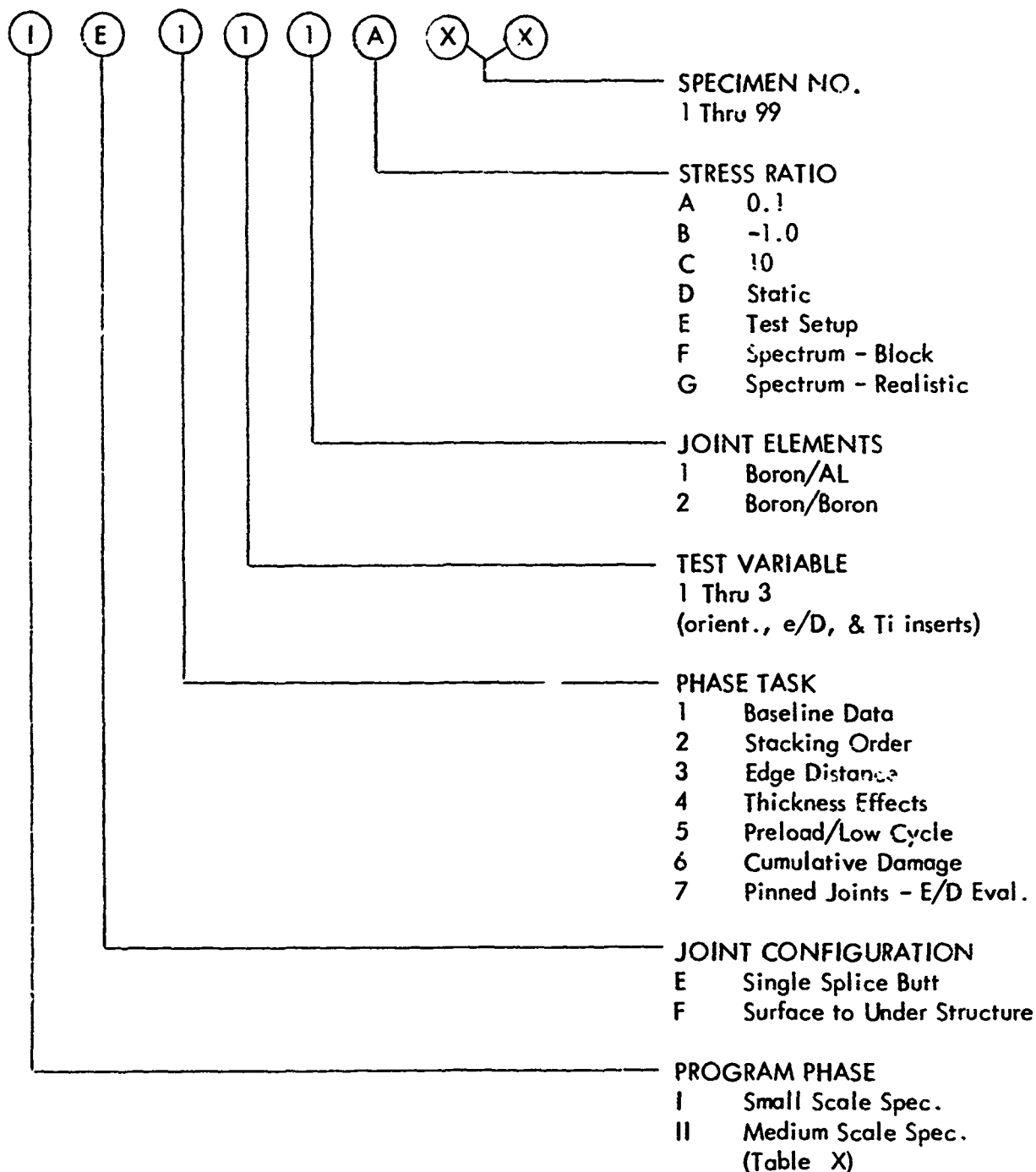
Specimen number IIIA11B2 identifies a specimen for Phase III with a single titanium splice plate butt joint configuration for evaluation of axial loading a stress ratio of $R = -1.0$. The specimen number within this set is number 2.

TABLE X
MECHANICAL JOINTS EVALUATION
SMALL AND MEDIUM SCALE SPECIMENS

PROGRAM SECTION	PHASE I - SMALL SPECIMEN				PHASE II - MEDIUM SPECIMEN				TOTALS	
	E"		F"		E"		TOTALS			
	Boron/Ti	Boron/Boron	Boron/AI	Boron/Ti						
JOINT CONFIGURATION	0.1	-1.0	10	(ST)	0.1	(ST)	0.1	(ST)	FAT	(ST.)
JOINT ELEMENTS	NUMBER OF SPECIMENS									
LOADING STRESS RATIO	17	10	3	(5)	5	(3)	10	(6)	56	17
PROGRAM TASKS	2	0° Ti Inserts			10	(3)			10	(3)
BASELINE DATA	5	5	5	(3)	5	(3)	10	(6)	56	17
	2	0° Ti Inserts			10	(3)			10	(3)
STACKING ORDER - 0°/±45°, ±45° Buildup	5	5		(3)					10	3
EDGE DISTANCE	5			(3)					5	(3)
1. 0°/±45°, Ti Inserts	6			(3)					6	(3)
2. 0°/±45°, ±45° Buildup										
THICKNESS EFFECTS										
1. 0°/±45°, Ti Inserts	5			(3)			5	(3)	10	(6)
2. 0°/±45°, ±45° Buildup	5			(3)					5	(3)
PRELOAD/LOW CYCLE 0°/±45°, Ti Inserts	10								10	
CUMULATIVE DAMAGE 0°/±45°, Ti Inserts										
1. Realistic Spectrum	5						5		10	
2. Block Spectrum	7						5		12	
PINNED JOINTS/EDGE DISTANCE EVALUATION										
1. (e/D) ₁ , Ti Inserts	5			(3)					5	(3)
2. (e/D) ₂ , Ti Inserts	5			(3)					5	(3)
3. (e/D) ₁ , ±45° Buildup	5			(3)					5	(3)
Sub Totals									149	47
TOTALS										

TABLE X (CONTINUED)

SPECIMEN IDENTIFICATION
MECHANICAL JOINTS - PHASE I & II



Specimen number IE311A03 identifies a specimen for Phase I with a single butt configuration for evaluation of fastener edge distance in a composite containing titanium skins joined to an aluminum splice plate. The specimen will be tested at a stress ratio of $R = +0.1$ and is specimen number 3 within the set of specimens.

4.2 GENERAL TEST EQUIPMENT

4.2.1 Static Test Machines

Static tests were performed in either a Riehle or Baldwin universal testing machine. The Riehle had a load capacity of $\pm 30,000$ pounds and the Baldwin $\pm 50,000$ pounds. Teplin or Instron grips, attached to the machine with spherically seated adaptors, were used for the tensile tests. Self-aligning hydraulic grips were used for the compression tests. The testing machines were calibrated to appropriate ASTM Specifications using standards traceable to the National Bureau of Standards.

4.2.2 Fatigue Test Machines

The majority of fatigue tests at a stress ratio, R , of $+0.10$ were performed in Lockheed designed fatigue machines that operate on the resonant principal. A sketch of one of these machines is illustrated in Figure 41. Each machine has flat grips which will accept specimens up to three inches wide and up to 18 inches in length. One grip is attached to an electrical resistance type strain gage load transducer and the other grip to the test machine base. Signal from the transducer is directed to a dynamic load analyzer which includes calibrated potentiometers, a carrier amplifier, and an oscilloscope. In operation, the carrier amplitude is set by the calibrated potentiometers to a value proportional to the desired load. The carrier is then amplitude modulated by the transducer signal until a null is achieved on the carrier amplitude, and the oscilloscope is used to display the null condition. Maximum, minimum, and mean loads are monitored in this manner. Each machine system is statically calibrated to an accuracy of ± 0.5 percent of load. A variety of transducers having different full-scale load capacities are available. However, the machines are limited to a maximum load of 15,000 pounds. Operating frequency range of the machines is 20 to 40 cycles per second and the operating frequency is established by the speed of the variable speed motor. The dynamic load at a given frequency is a function of the variable eccentric setting, variable mass of the machine, and position of the grips in the machine. Mean load is applied by a hydraulic

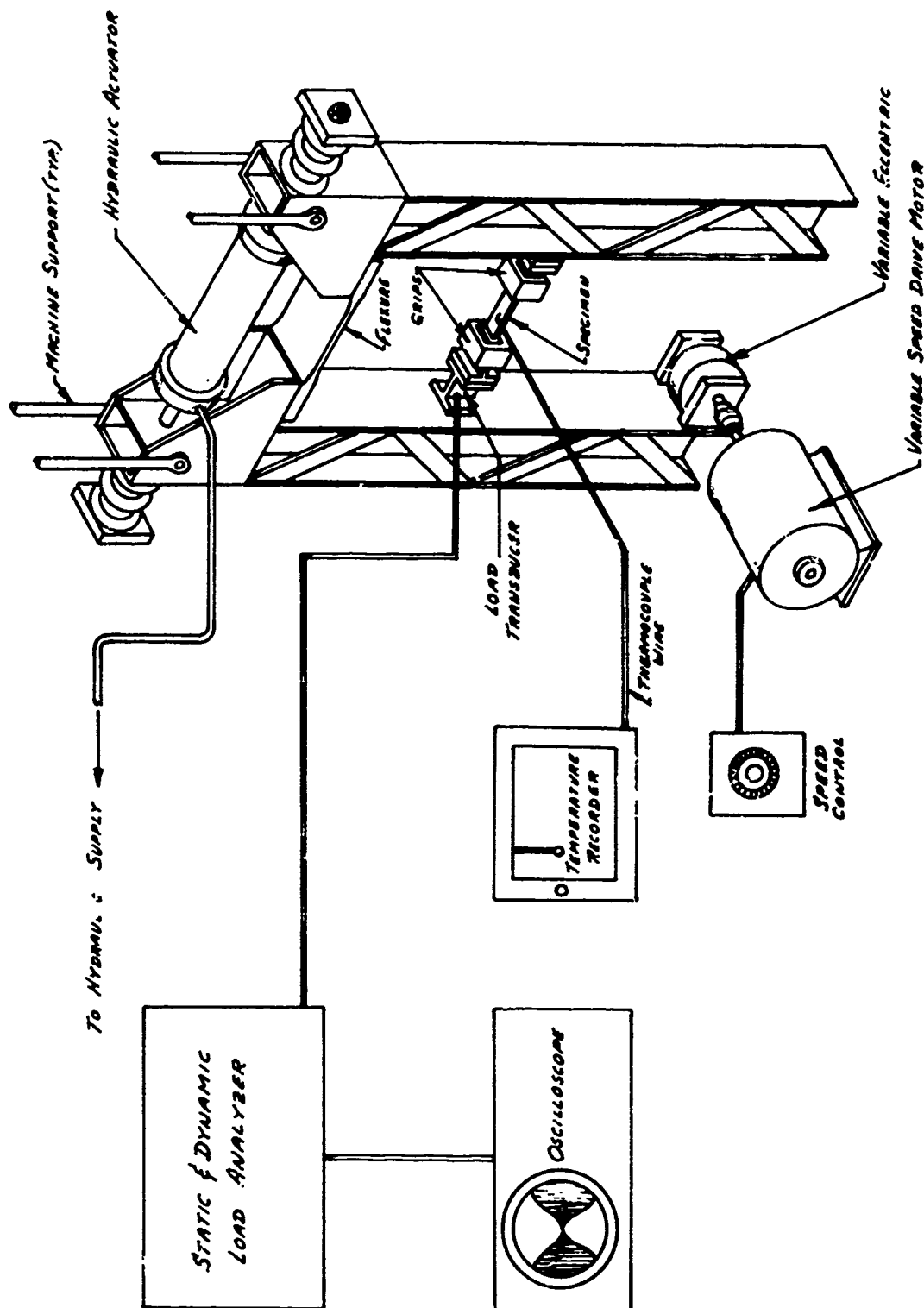


FIGURE 41 - RESONANT FREQUENCY FATIGUE MACHINE

actuator on most of the machines, although some have a mechanical screw for this purpose. Each machine has an automatic cut-off system which stops the motor and cycle counter upon specimen failure.

Fatigue tests at stress ratios of $R = -1.0$ and $R = +10.0$ were performed in electro-hydraulic servo controlled testing machines, Models 301 and 303, manufactured by MTS System Corporation. These are direct force-type machines having full scale fatigue load capacities of $\pm 30,000$ pounds and $\pm 100,000$ pounds respectively. The lowest load range is 5,000 pounds on the Model 301 and 10,000 pounds on the Model 303. Each machine is equipped with MTS Alignomatic grips. Photographs of the testing machines are presented in Figure 42 and Figure 43. The electro-hydraulic servo controlled closed loop system provides infinite control of test frequency from approaching zero to limits of system response which is a function of hydraulic supply capacity, the servo valve, and test specimen compliance. Each MTS system was statically calibrated to an accuracy of $\pm 0.2\%$ of load range.

4.2.3 Programming Equipment

The programming equipment used for the block loading and realistic spectrum testing was manufactured by MTS Systems Corporation. It can be used to control either of the MTS fatigue testing machines and a photograph of the Model 301 machine with the computerized programming equipment is shown in Figure 42 with the 30,000 pound MTS machine. The hardware consists of a PDP-8L computer, a model 33 ASR teletypewriter set, and an MTS 433.11 interface unit. The computer is prepared by means of an appropriate software program and test load information is input either manually on the teletype keyboard or by tape format on the tape reader. The digital format is then converted to a series of voltage commands by a digital to analogue converter located in the interface unit. Each command voltage is applied to the servo valve controller on the testing machine console and load is applied to the specimen. The load cell in the machine reacts the specimen load and a feedback voltage is created. This voltage is fed back to the interface unit where it is converted from an analogue signal to a digital value. The computer then screens and compares the digital command and feedback to verify that the specimen is subjected to the correct loadings. If any variations exist between command and feedback



FIGURE 42 - MODEL 301 MTS MACHINE - 30,000 POUNDS

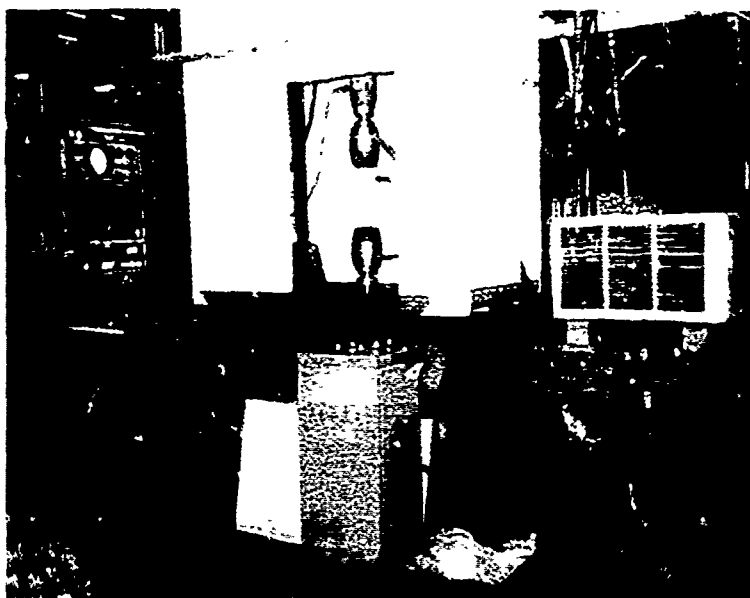


FIGURE 43 - MODEL 303 MTS MACHINE - 10,000 POUNDS

the program automatically halts. Accuracy of the programming system was found to be within $\pm 0.5\%$ of selected load range.

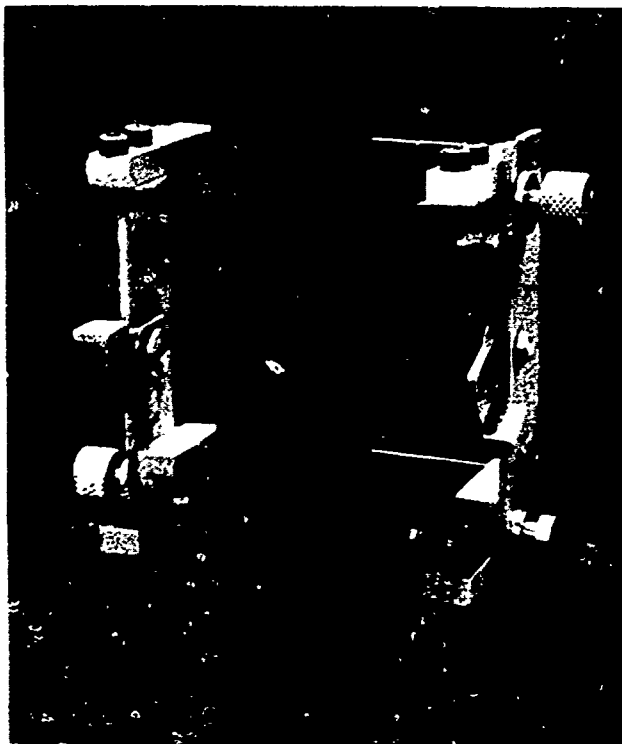
4.2.4 Instrumentation and Recording Equipment

Environmental and specimen temperatures were measured by copper-constantan thermocouples connected to Honeywell multichannel strip-chart recorders. Since it was necessary to monitor temperatures at regular intervals throughout the duration of a test, each recorder was equipped with an automatic on/off control device. This device was set to switch the recorder on for approximately thirty seconds at intervals ranging from 15 minutes to 4 hours depending upon test duration. Resistance strain gages, types FAE-03-12S13 and FAE-06N-12S13 were used on the strain survey specimens and strains were recorded on either a Baldwin strain indicator or a B&F Strain Data Acquisition System, Model SY156. Basic composite material modulus and joint stiffness were determined with an SR-4 frame extensometer equipped with strain gaged leaves as shown in Figure 44. A gage length of 2.0-inches was used for the bonded joints and a 3.25-inch gage length was used for the mechanically fastened joints. Strain was recorded on the x-axis of an autographic recorder on the universal testing machine. During cumulative damage testing the specimen loads were monitored on a calibrated Clevite-Brush strip chart recorder, Mark 280.

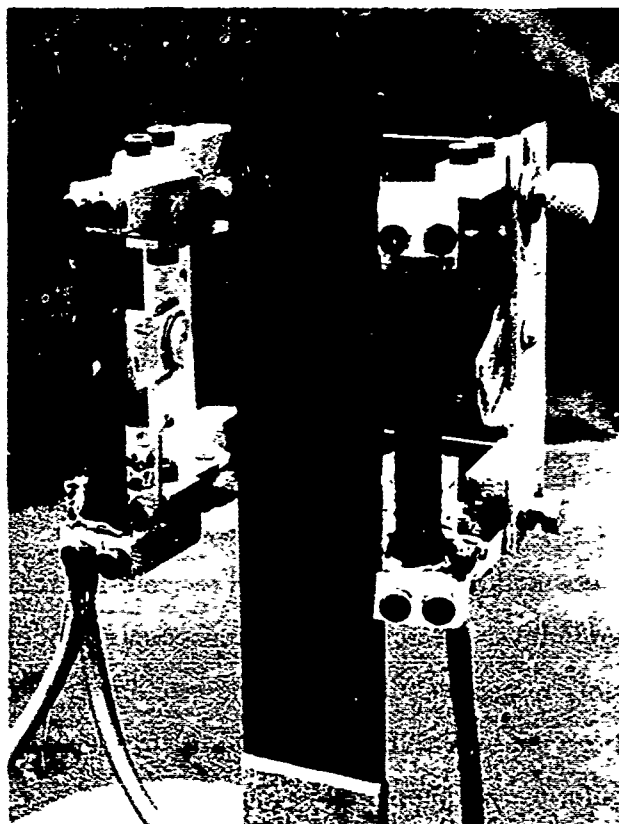
4.3 GENERAL TEST REQUIREMENTS AND TEST METHOD APPROACH

The critical dimensions of each specimen were measured and recorded along with its unique serialization. All tests were conducted at a room temperature of $72 \pm 5^\circ$ Fahrenheit and any increase in specimen temperature was restricted to $+10^\circ\text{F}$ unless stated otherwise elsewhere in the report.

The fatigue tests were conducted at a variety of cyclic rates which were generally dependent upon stress level and stress ratio. However, the maximum frequency was limited to 1800 cycles per minute. Actual stress levels, stress ratios, and cyclic rates are given for each fatigue test in the test data tables, Appendix B.



Extensometer on Specimen



Strain Gage Leaves On
Extensometer

FIGURE 44 - EXTENSOMETER SET-UP FOR
MEASURING SPECIMEN STRAIN

4.4 MATERIAL VERIFICATION TESTS

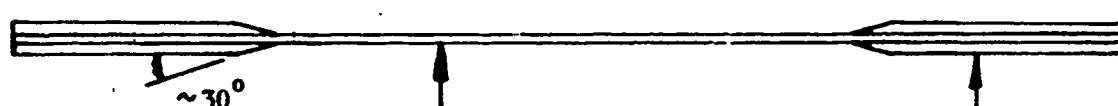
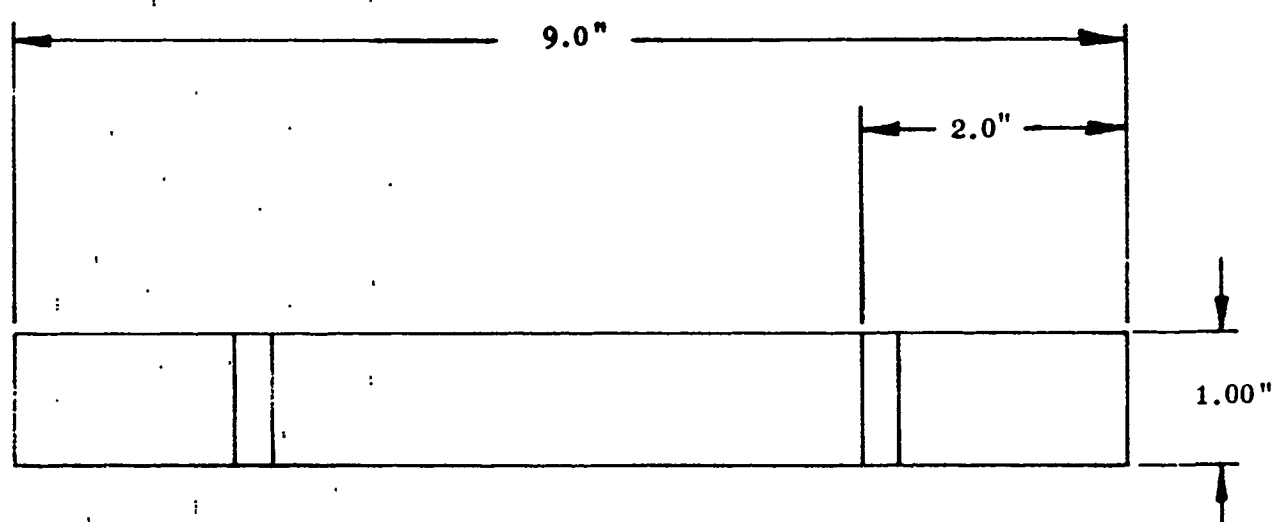
4.4.1 Specimen Configurations

The configuration of the static tensile and axial-load fatigue test specimen at $R+0.1$ is shown in Figure 45. The axial-load, $R = -1.0$ fatigue test specimen configuration is shown in Figure 46. Two tab materials were evaluated; half of the $R = -1.0$ fatigue specimens were fabricated with fiberglass tabs and the other half with aluminum tabs. The specimen configuration used for the adhesive evaluation tests is as shown in Dwg. No. 7226-13021A, but with titanium adherends and splice plate. Specimen identification information is given on Table VI.

4.4.2 Test Procedure and Results

Tests were conducted in accordance with Table VI, and the test data are reported in Appendix B, Table B1. The basic material static test specimens were instrumented with three strain gages as shown in Figure 45. A 2.0-inch gage-length extensometer was attached to each specimen and load was applied incrementally to failure. Strain gage output was recorded at each load increment and the extensometer output was plotted against load on an autographic recorder. Good correlation was obtained between the measured results of the two systems as illustrated in the response curve of Figures 47 and 48.

Constant amplitude axial-load, $R = +0.10$ fatigue tests were conducted in Lockheed designed resonant testing machines, Figure 41. One thermocouple was bonded to each specimen at the center of its length and was used to monitor specimen temperature for the duration of the test. Ambient temperature was measured by a thermocouple bonded to a piece of boron-epoxy composite material, suspended from the testing machine in the proximity of the test specimen. Typical fatigue failures for the $R = +0.10$ fatigue specimens with $0^\circ/+45$ and $0^\circ/90$ fiber orientations are presented in Figure 49.



Two material 7 ply glass
fiber/epoxy laminates
 $0^\circ/90^\circ$, bonded with EPON
9601 adhesive

FIGURE 45 - AXIAL-LOAD FATIGUE TEST SPECIMEN CONFIGURATION $R = +0.10$

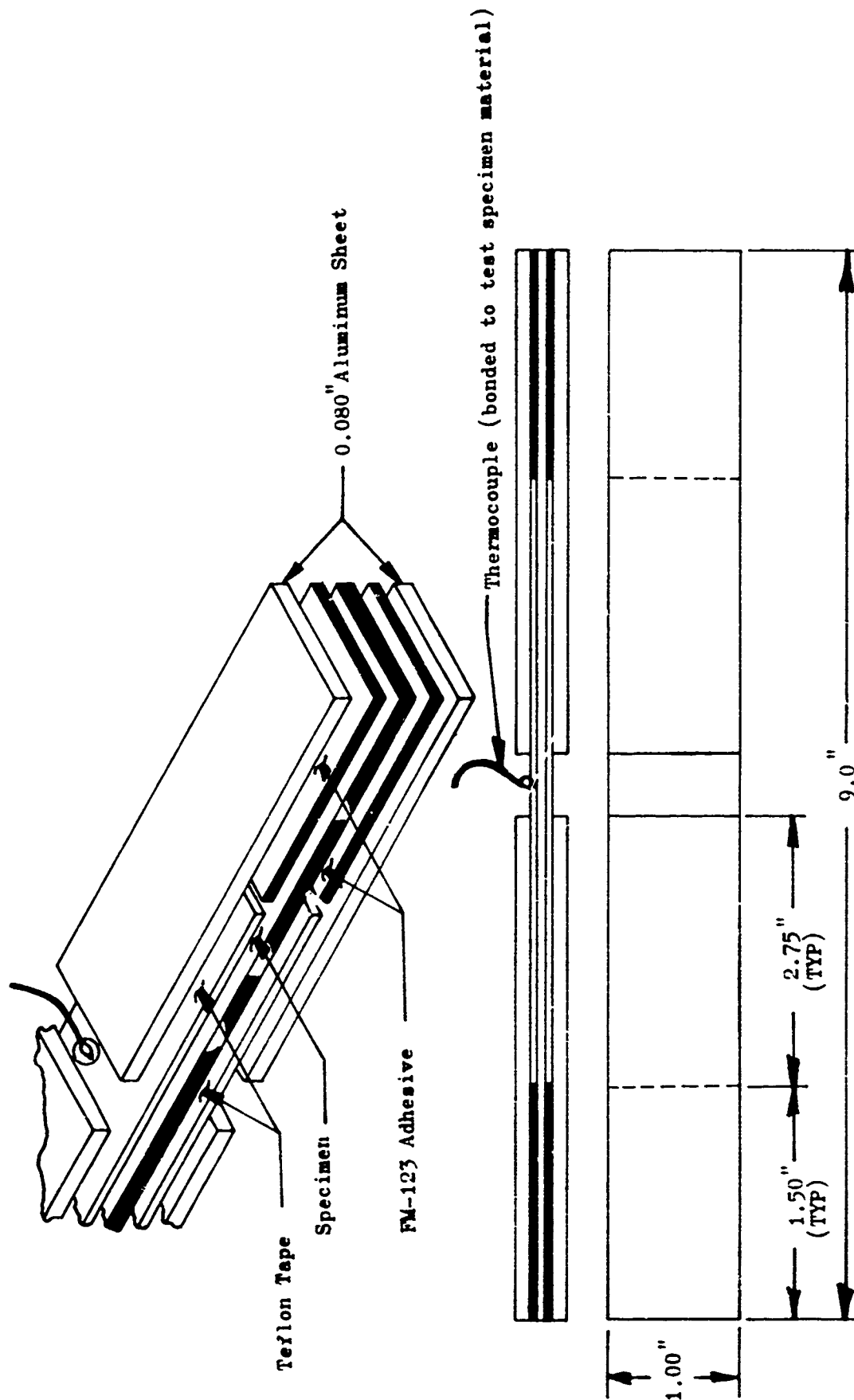


FIGURE 46- AXIAL-LOAD, NEGATIVE STRESS RATIO FATIGUE TEST SPECIMEN CONFIGURATION

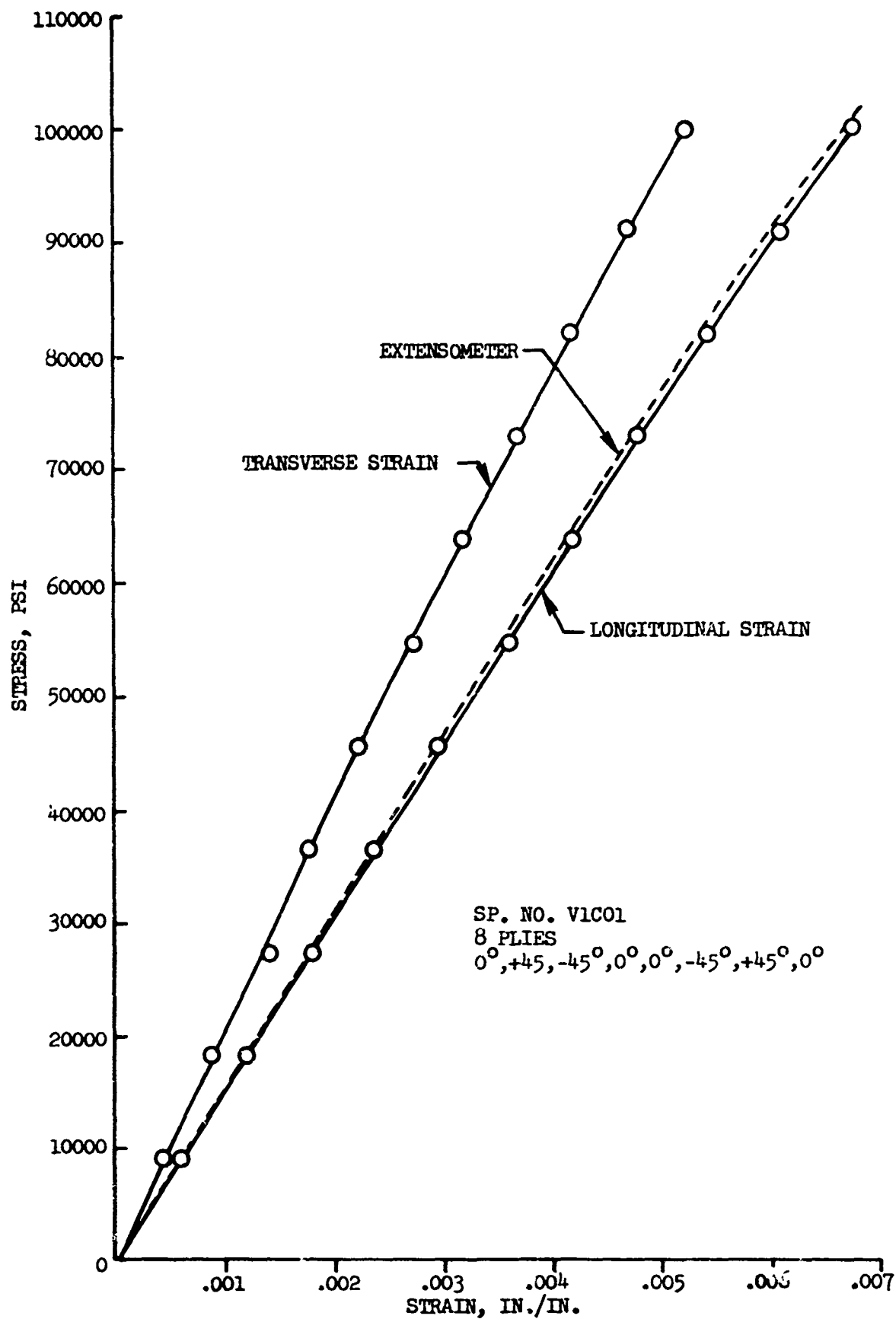


FIGURE 47 STRESS-STRAIN RELATIONSHIP TENSILE COUPON 0°₋45°

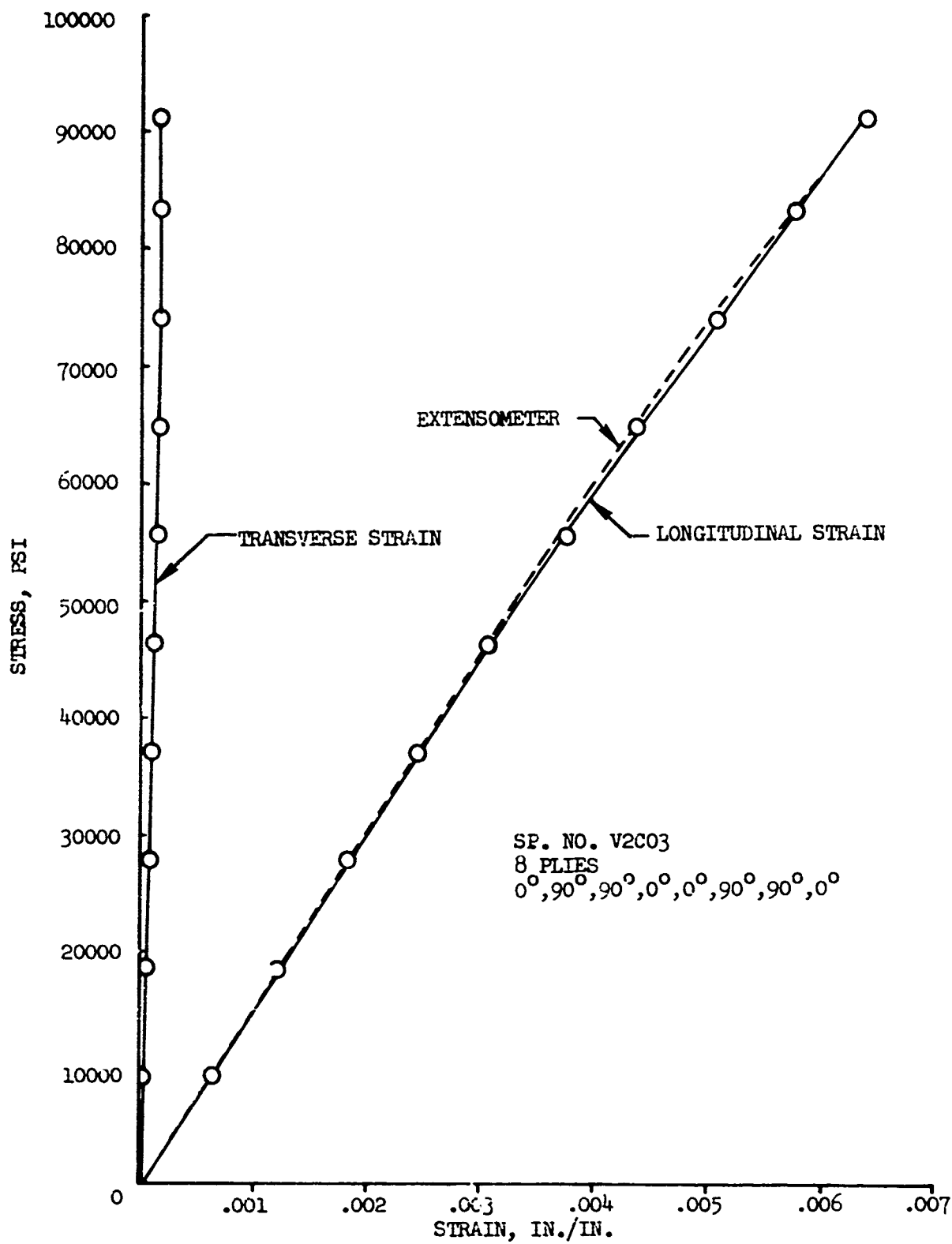


FIGURE 48 STRESS-STRAIN RELATIONSHIP TENSILE COUPON - 0°/90°

Constant amplitude axial-load, $R = -1.0$ fatigue tests were conducted in an MTS electro-hydraulic servo controlled closed loop testing system. One thermocouple was bonded to each test specimen at the center of its length as shown in Figure 46. Two aluminum support plates, approximately 5 inches long X 2 inches wide X 0.25-inch thick, were attached to the specimen, one on each side and held together by six 0.25-inch diameter fasteners. The fastener nuts were tightened to provide adequate lateral support for compressive loading without creating excessive friction between the plates and specimen during axial loading. Typical failures for the $R = -1.0$ fatigue specimens with aluminum tabs and fiberglass tabs are shown in Figure 50. Due to difficulties encountered with an excessive temperature rise in the $R = -1.0$ specimens, the tests were repeated and the problem was solved by restricting the test cyclic frequency to 180 cycles per minute. All previous test results had indicated that the aluminum-tabbed specimens gave comparable fatigue data to that of the fiberglass-tabbed specimens and the repeated tests confirmed this (see Figure 51). Since the aluminum tabs were more uniform in thickness and easier to use than the fiberglass tabs, it was felt that it would be advantageous to use aluminum tabs on all future joint specimens.

Prior to conducting the adhesive evaluation tests some experimental testing was carried out to determine a satisfactory support plate system. A quantity of test specimens with titanium splice plates bonded to titanium adherends were fabricated. Initially, support plates were attached to the adherends spanning the splice plate but not offering any support to the splice plate. This method was considered non-representative since the splice plate was still free to deflect a substantial amount when loaded. Using the same basic support plates, spacers were placed in the gap between the spliced area on both faces. These spacers were 1.0-inch wide and of sufficient thickness to completely fill the gap without providing an interference fit. Testing indicated that this method was successful but it was felt that, since the joint was only supported over the center 1.0 inch of its total overlap length of 1.5 inches, to offer similar support to a joint of different overlap length the spacer length would also have to be different and therefore complicate the testing procedures. Finally it was decided that the joint should be supported across the whole overlap area but still allowed to deflect a limited amount.

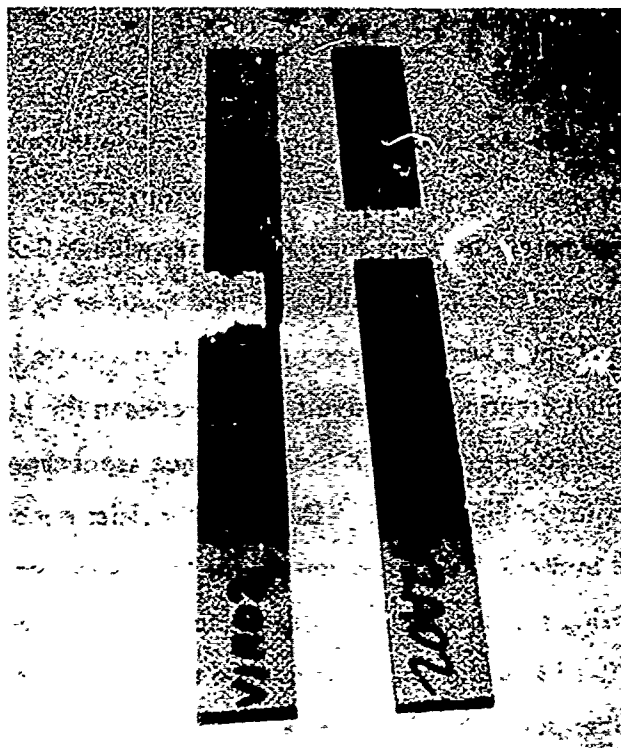


FIGURE 49 - TYPICAL FAILURE,
AXIAL FATIGUE $R = +0.10$

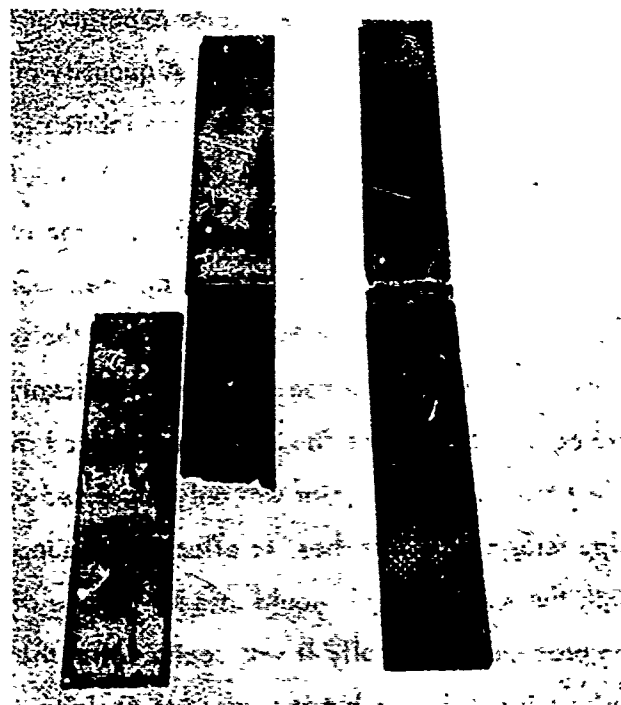


FIGURE 50 - TYPICAL FAILURE,
AXIAL FATIGUE $R = -1.0$

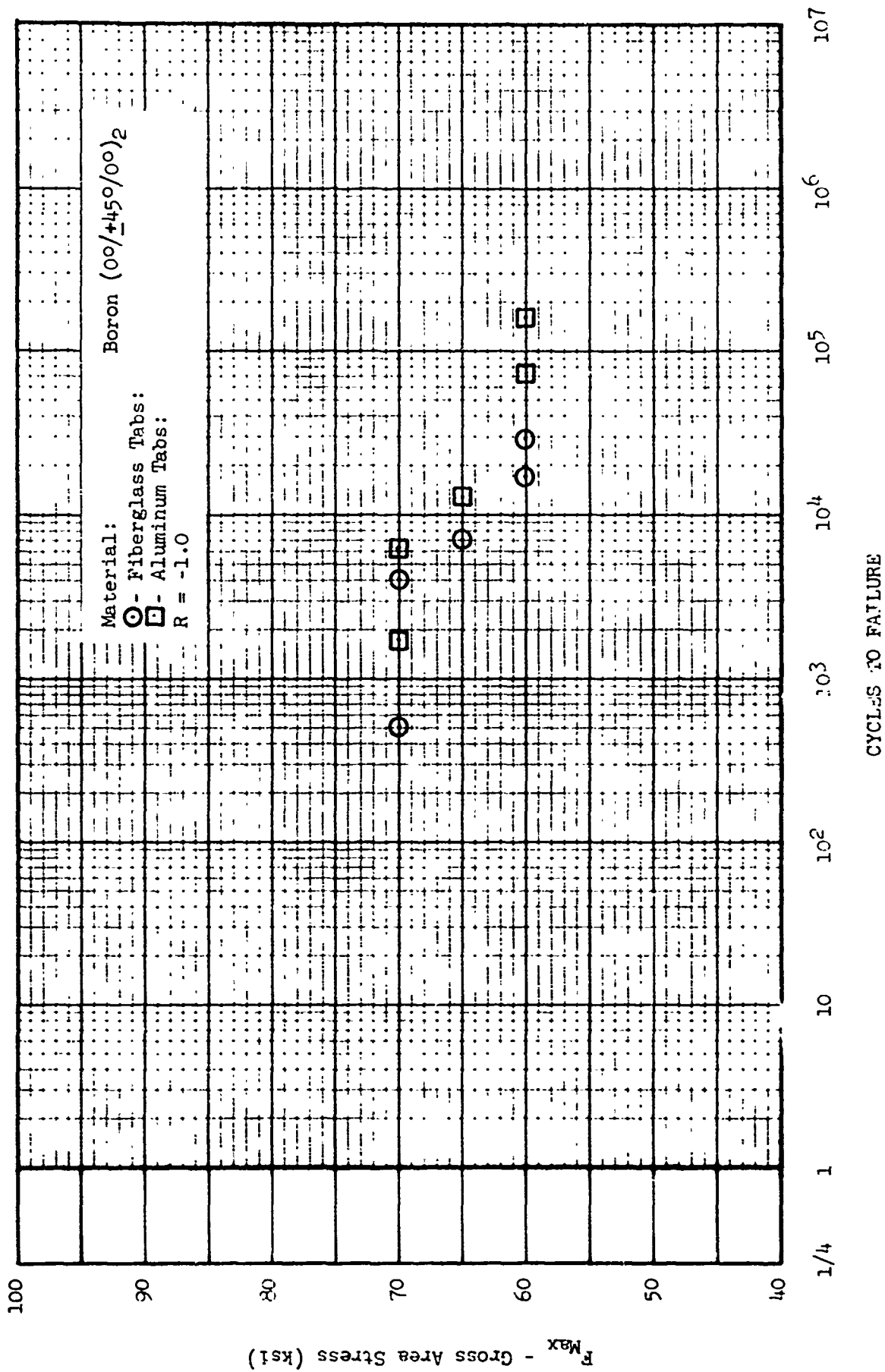
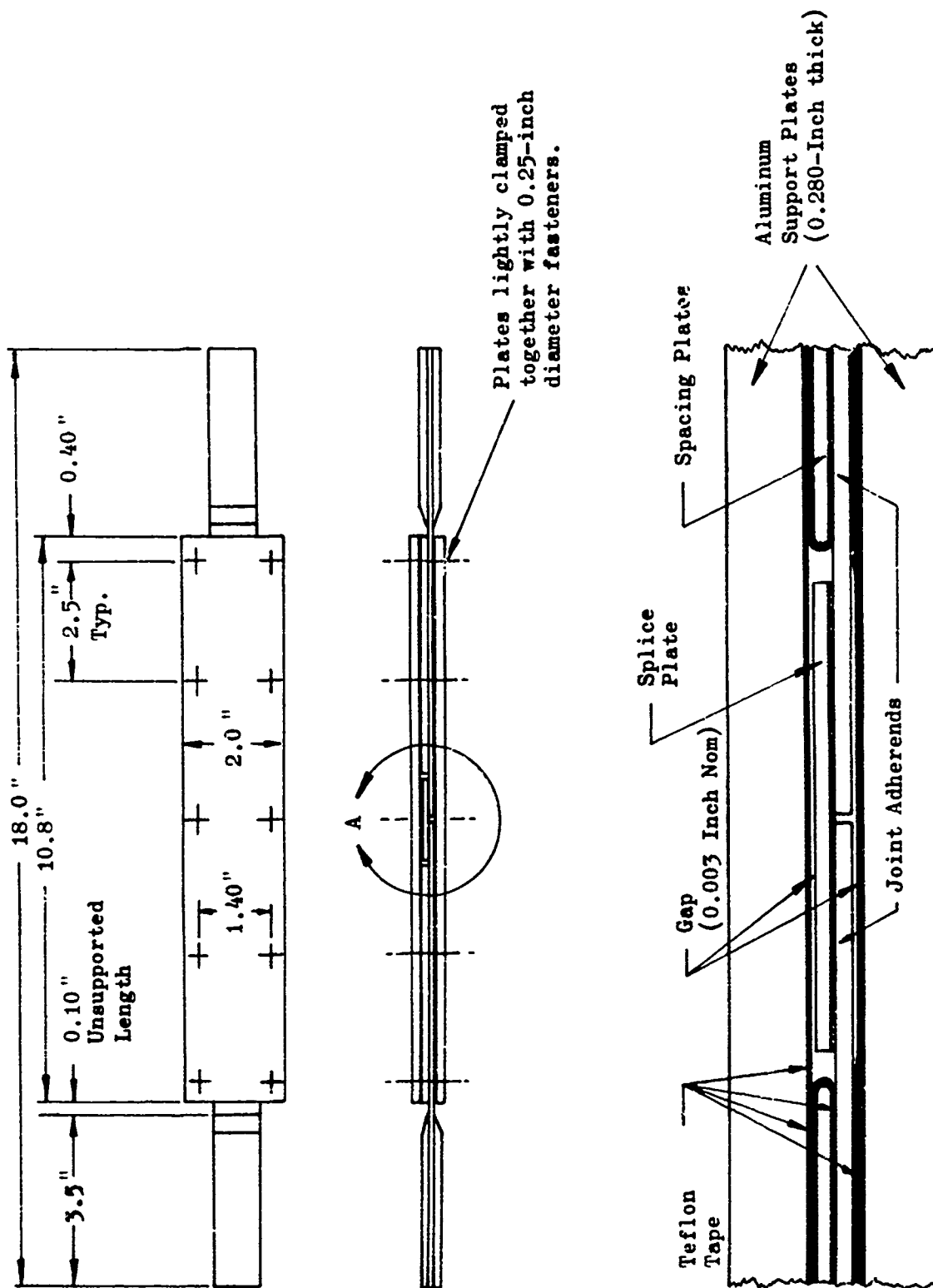


FIGURE 31 - MATERIAL VERIFICATION FATIGUE TEST

This condition was believed to be representative of a typical joint between skins bonded to a honeycomb core or supported by a substructural member. The system that satisfied these requirements was successfully checked out on additional specimens fabricated with boron composite adherends and at various stress levels and stress ratios (see Table B2, Appendix B). Details of the support system that was adopted for Configuration A bonded joint test specimens are given in the sketch, Figure 52. The gap on each side of the joint was restricted to 0.003 inch (one thickness of Teflon tape) since this provided adequate and representative support to the joint without creating any significant frictional resistance when loaded. One of the experimental joint specimens with support plates attached and mounted in a resonant fatigue machine is shown in Figure 53.

The static and fatigue adhesive evaluation tests were conducted using the support plate system described above. Typical static and fatigue failure surfaces are shown in Figures 54 and 55. The Epon 9601 adhesive exhibited high ultimate shear strength and the S-N curve, shown in Figure 56 indicates that the fatigue characteristics were also acceptable.



VIEW "A"

FIGURE 52 SUPPORT SYSTEM FOR TYPE "A" JOINT SPECIMENS

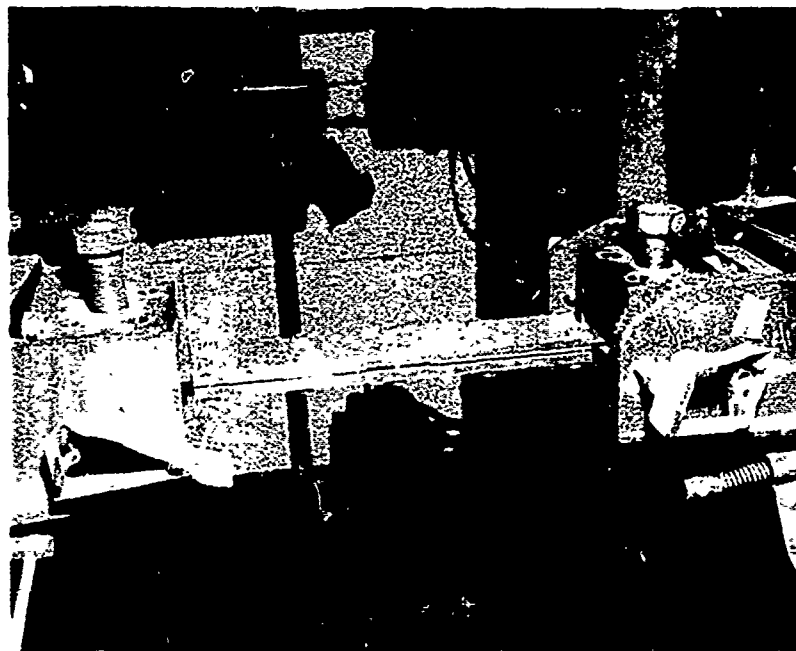


FIGURE 53 - TEST SPECIMENS WITH SUPPORT PLATES



FIGURE 54 - TYPICAL STATIC FAILURE SURFACE
TITANIUM TO TITANIUM (V3C03)

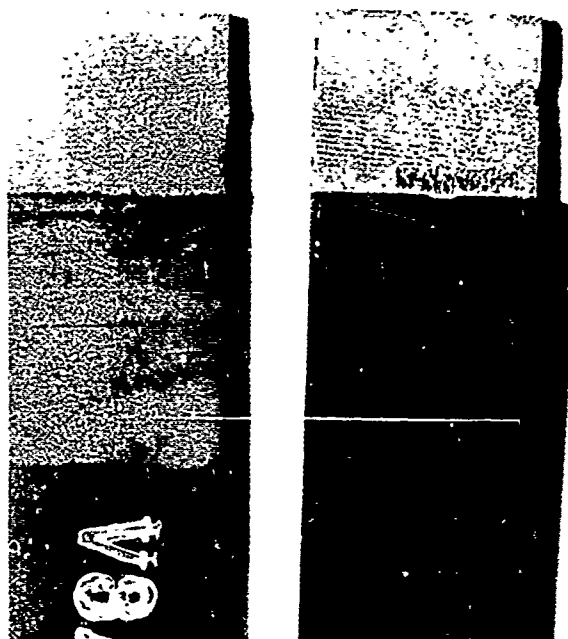


FIGURE 55 - TYPICAL FATIGUE FAILURE SURFACE
TITANIUM TO TITANIUM (V3A12)

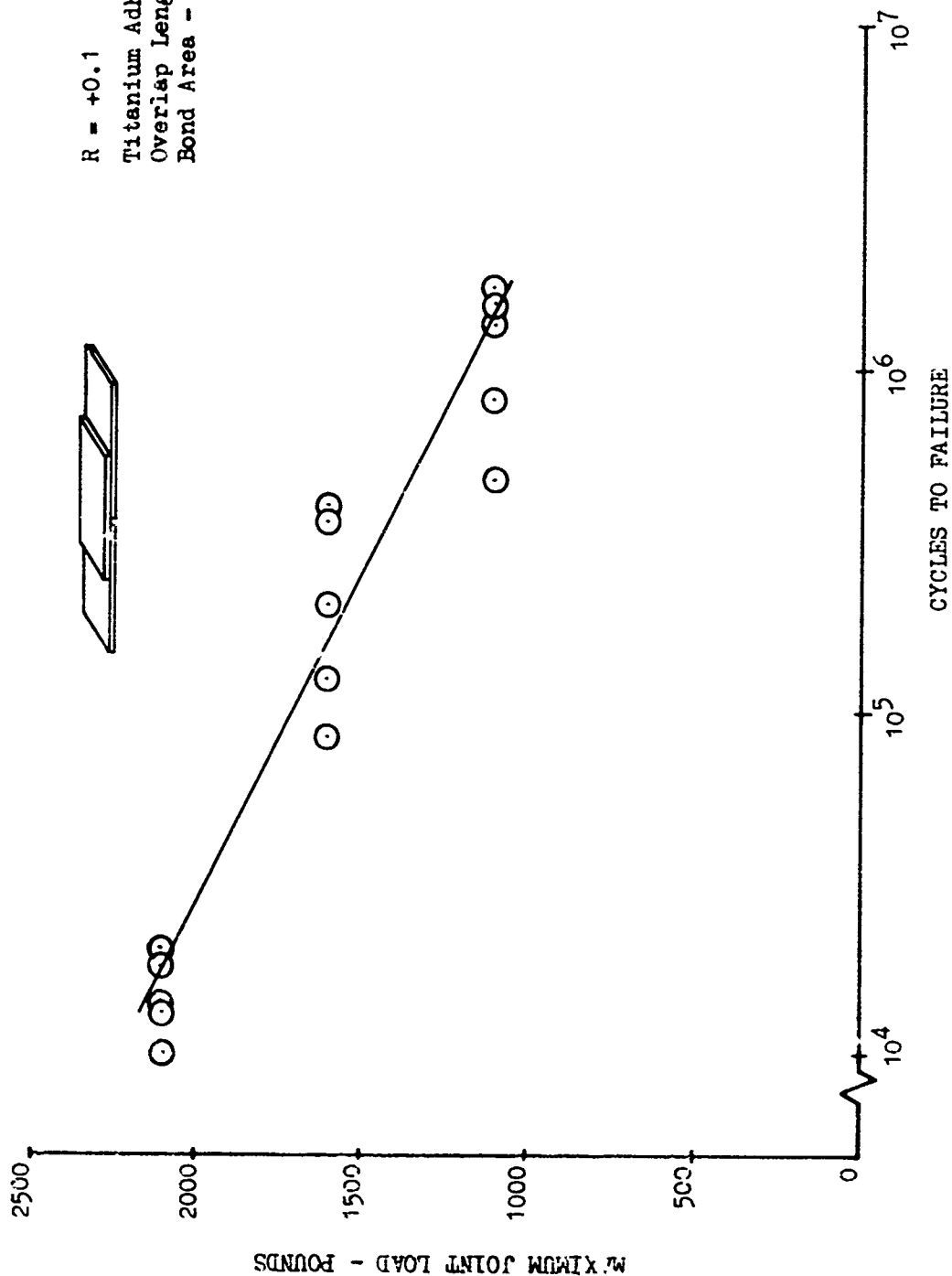


FIGURE 56 S-N CURVE FOR SINGLE SPLICE BUTT JOINT
CONFIGURATION A - EPON 9601 ADHESIVE

4.5 BONDED JOINT TESTS - CONFIGURATION A - SINGLE SPLICE BUTT JOINT

4.5.1 Specimen Configuration

The Phase I, Configuration A specimen details are given in Dwg. No. 7226-13021A, Appendix C. The Phase II and Phase III specimens were fabricated to the same drawing but the width dimension was increased to 3.0 and 10.0 inches respectively. Specimen identification information is given on Tables VII, VIII, and IX.

4.5.2 Test Procedure and Results - Phase I

Tests were conducted in accordance with Table VII, and the test data are reported in Appendix B, Tables B3 thru B9.

Tests were also conducted on alternate adherend materials in accordance with Table I and the test data were reported in Appendix B, Table B17. The static tensile test specimens were supported with the modified support plates shown in Figure 57. The modification to the plates was necessary to allow a 2.0-inch gage-length extensometer to be attached to the edges of the specimen. A typical static tensile test set-up with extensometer attached is shown in Figure 58. A minor problem was caused by the buckling of the lateral support plates during the static compression testing of the long lap joint specimens. The buckling was a result of the higher loads required to fail this type of specimen combined with the effect of the reduced stiffness of the plates due to the cut out at the center. Increased stiffness to the support plates was provided by attaching a "T" section stiffener along the length of and on one side of the support plates as shown in Figure 59 and Figure 60. A thermocouple was bonded to each specimen and was located on the adherend adjacent to the edge of the splice plate. The fatigue tests were conducted in the fatigue machines described earlier and with regular support plates. Figures 61, 62 and 63 illustrate the different failure modes obtained with the Configuration A baseline specimens when subjected to the different fatigue stress ratios of $R = +0.10$, $R = -1.0$, and $R = +10.0$. Failure modes associated with the ply stacking variable, surface ply at 45° to load axis, for Configuration A boron-to-titanium and

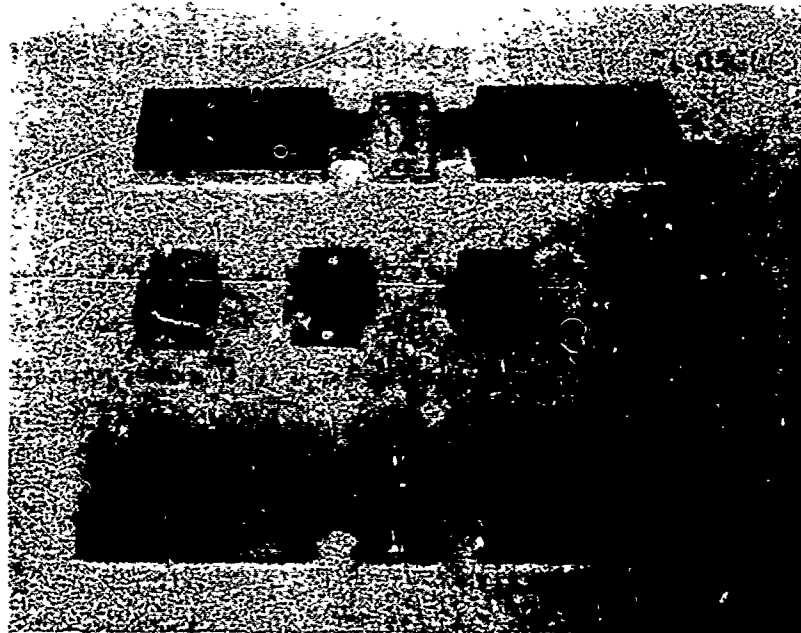


FIGURE 57 MODIFIED SUPPORT FIXTURE

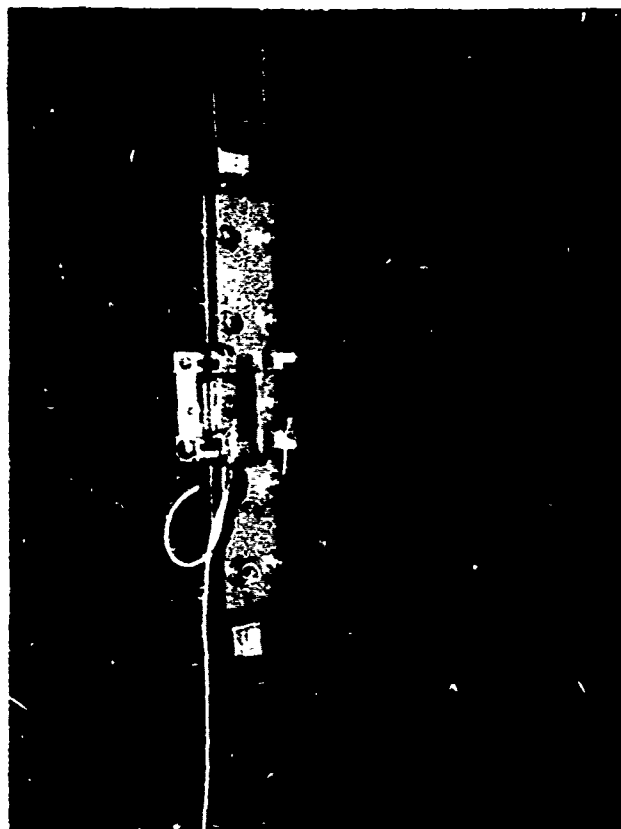


FIGURE 58
STATIC TENSILE TEST
WITH EXTENSOMETER

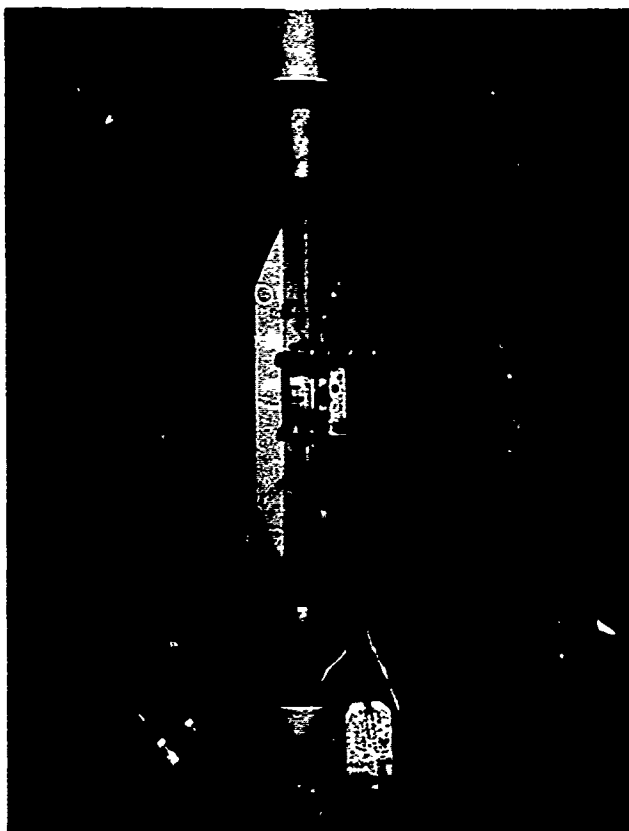


FIGURE 59
SIDE VIEW OF MODIFIED
SUPPORT PLATE

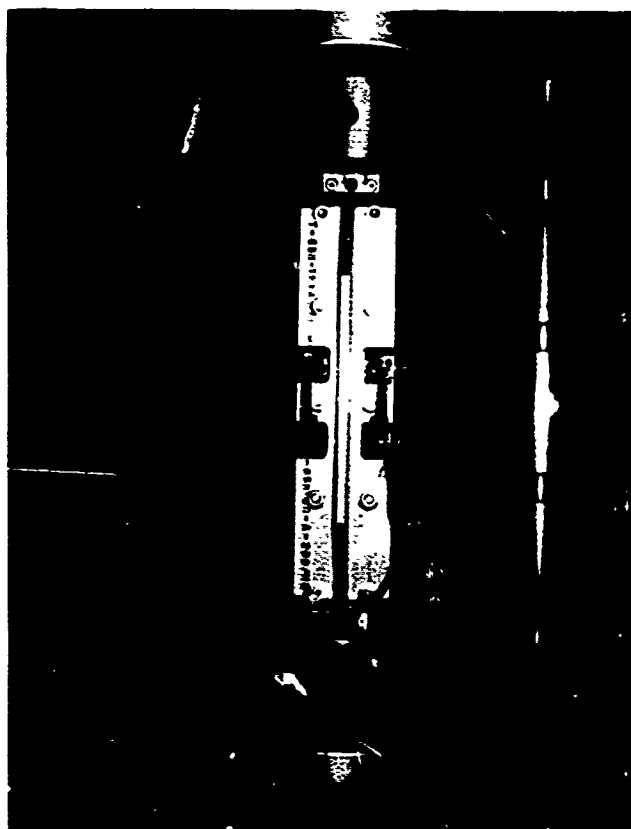


FIGURE 60
FRONT VIEW OF MODIFIED
SUPPORT PLATE

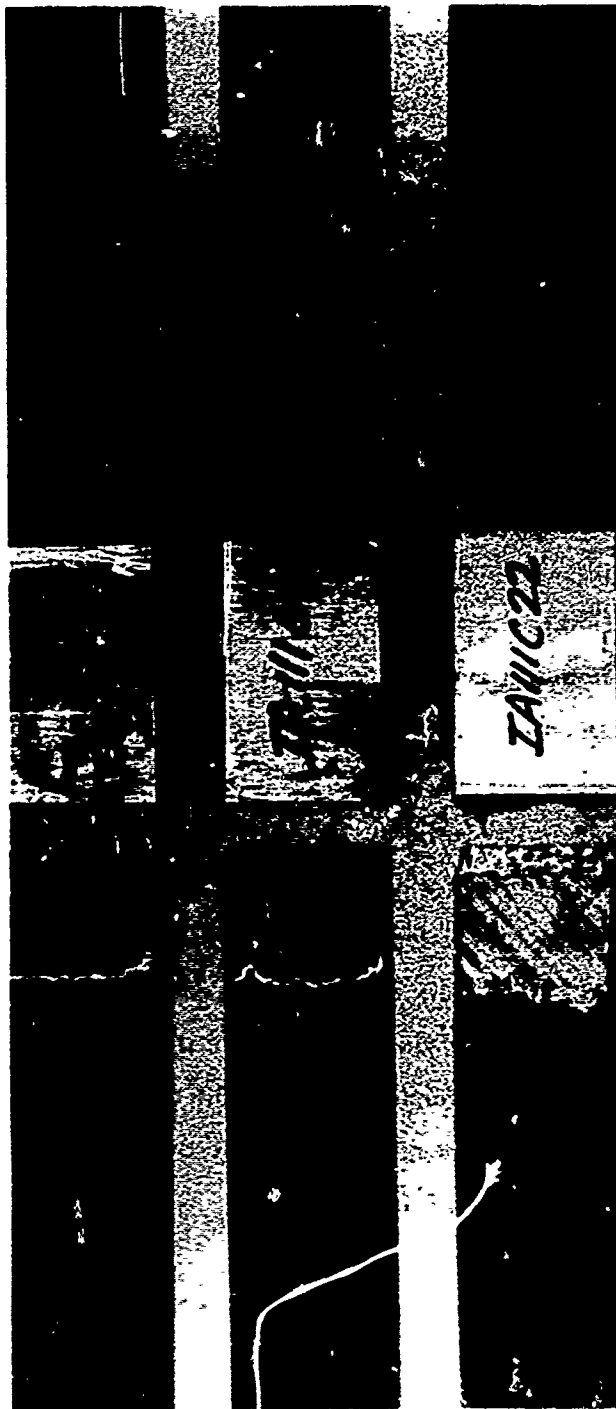


- A04 shows unusual splice plate failure
- A10 shows typical failure adjacent to surface ply

FIGURE 61 - CONFIGURATION A, BORON TITANIUM BASELINE SPECIMEN
STRESS RATIO $R = +0.1$



FIGURE 62 - CONFIGURATION A, BORON/TITANIUM BASELINE SPECIMEN
STRESS RATIO $R = -1.0$ TYPICAL FAILURES



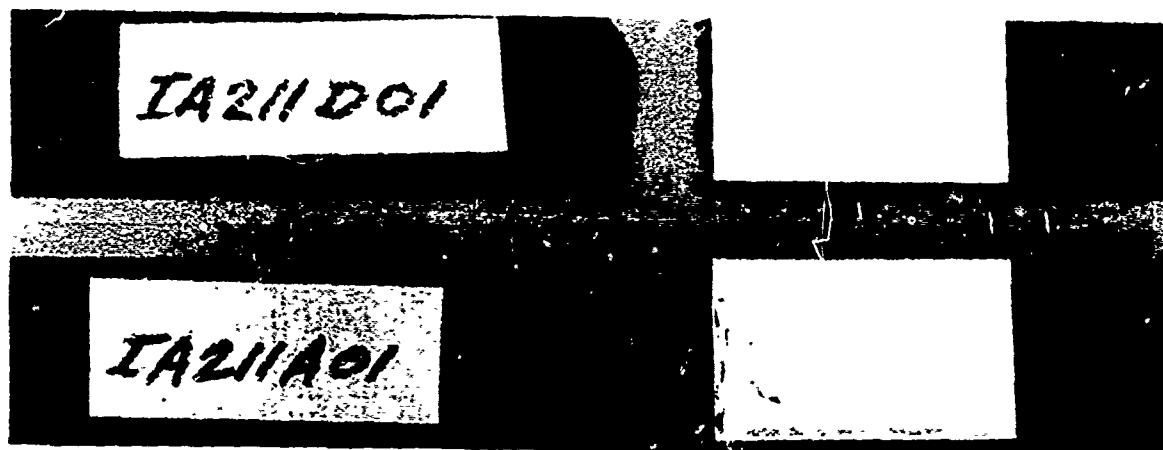
- C01 Failure adjacent to surface ply plus some end damage
- C10 Failure adjacent to surface ply and no secondary damage
- C22 Failure between surface ply and 45° ply

FIGURE 63 - CONFIGURATION A, BORON/TITANIUM BASELINE SPECIMEN STRESS RATIO
R = +10.0. TYPICAL FAILURES

boron-to-boron joints are shown in Figures 64 and 65. In addition to the degradation specimens, all other types of Configuration A fatigue specimens that had not been failed during testing were statically tested to failure. Joint deflection was recorded for each specimen to determine possible degradation in joint stiffness due to fatigue loading. The low cycle tests were conducted in an MTS electrohydraulic servo controlled closed loop system at a frequency of 5 cycles per second. An attempt was made to obtain fatigue lives of between 2500 and 5000 cycles, however this proved to be difficult and the test data produced a scatter band of about two decades.

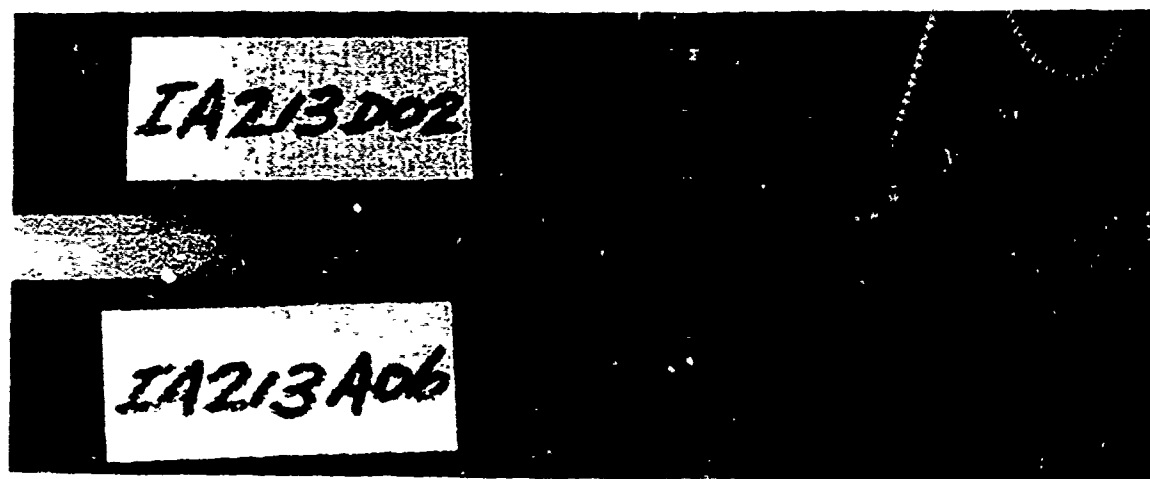
Good static shear strengths were obtained for the joints loaded in tension with values ranging from 3600 psi to 5700 psi and with an average value of 4600 psi. This spread in static strength is reasonable when comparing results from specimens representing several different batches of material bonding cycles and L/t ratios. Compressive shear strength values varied between 5500 psi and 6300 psi. Additional baseline data tests were conducted at a stress ratio of $R \approx -1.0$ and at a cyclic rate of one cycle per second to determine the influence of cyclic rate on fatigue life. These yielded the same results as tests conducted at 900 to 1800 cycles per minute, indicating that cyclic rate is not a prime factor unless it causes the specimen to overheat. Joint stiffness curves for tensile and compressive static loading before and after fatigue cycling are given in Figures 66 thru 69. Boron-to-boron joints with the second adhesive, Metlbond 329, were evaluated and the results are reported in Appendix B, Table B4. Since static tests on boron-to-titanium joints with this same adhesive yielded low static strength values, and initial fatigue test results were also low (all specimens failed at the adhesive-titanium interface) testing on the remainder of the specimens was suspended because these specimens did not evaluate the adhesive to composite joint.

For the preload evaluation tests, static tensile preloads were determined by taking 75 percent, 85 percent, and 90 percent of a predetermined static value established as the design ultimate shear stress. This stress was 4000 psi and was determined by deducting one standard deviation from the mean value of all the static tensile ultimate values obtained for the standard boron/titanium, Configuration A joint specimens. Joint deflection was recorded during the static preload to provide additional information. Fatigue



- D01 Typical static tensile failure in boron
- A01 Typical $R = +0.1$ fatigue failure between surface 45° ply and second 0° ply

FIGURE 64 - CONFIGURATION A, BORON/TITANIUM PLY STACKING SPECIMEN



- D02 Typical static tensile shear failure between surface 45° ply and second 0° ply
- A06 Typical $R = +0.1$ fatigue failure (same as D02)

FIGURE 65 - CONFIGURATION A, BORON/BORON PLY STACKING SPECIMEN

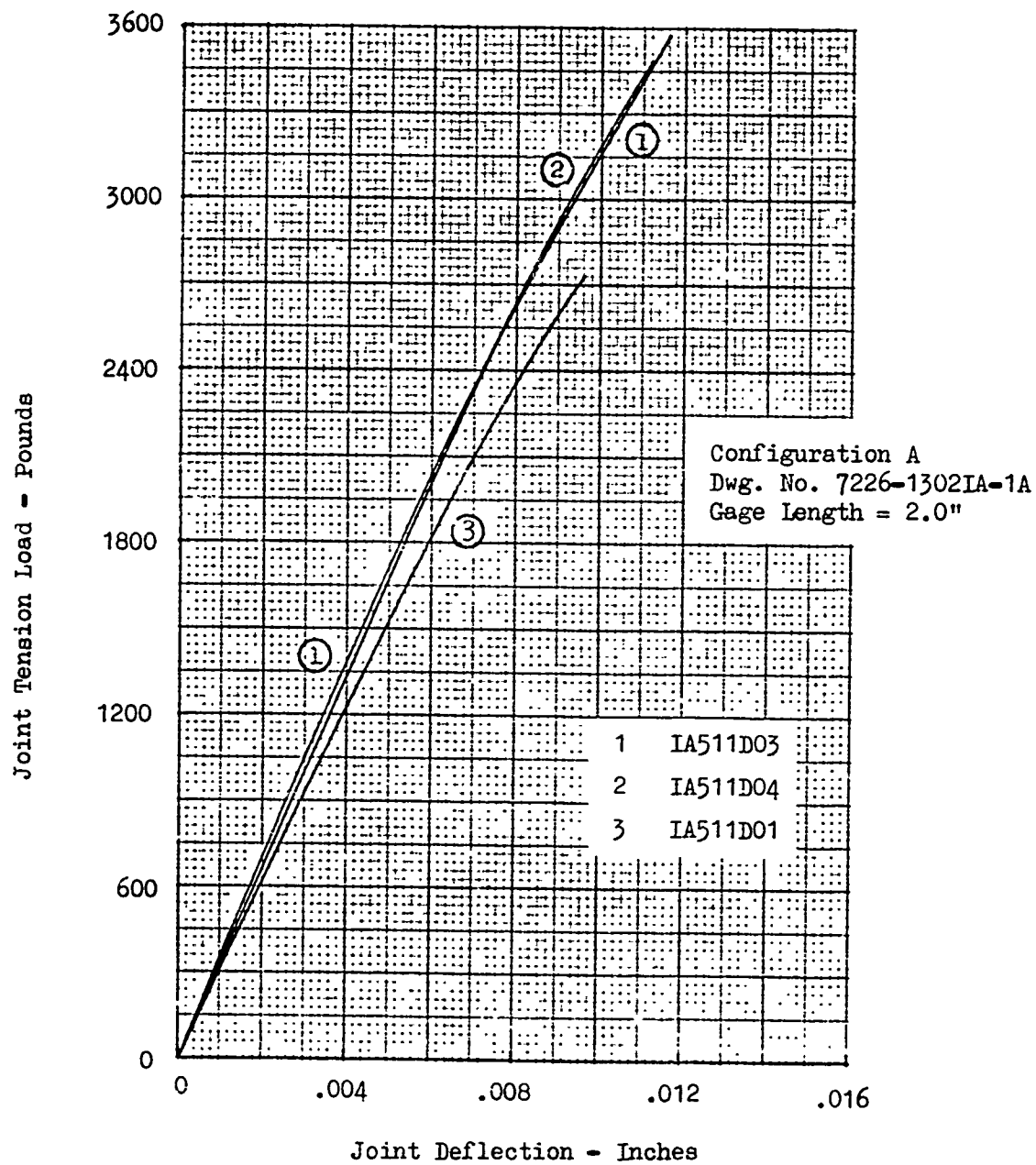
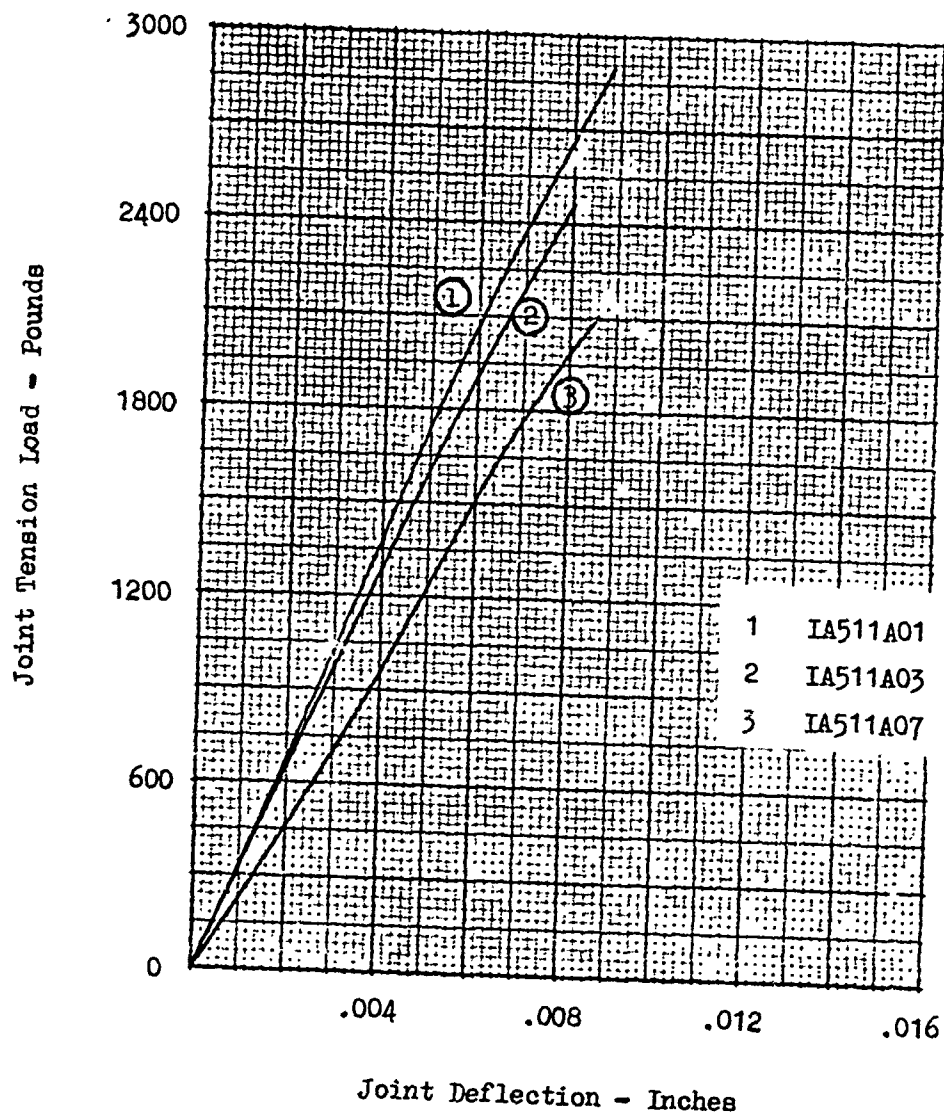
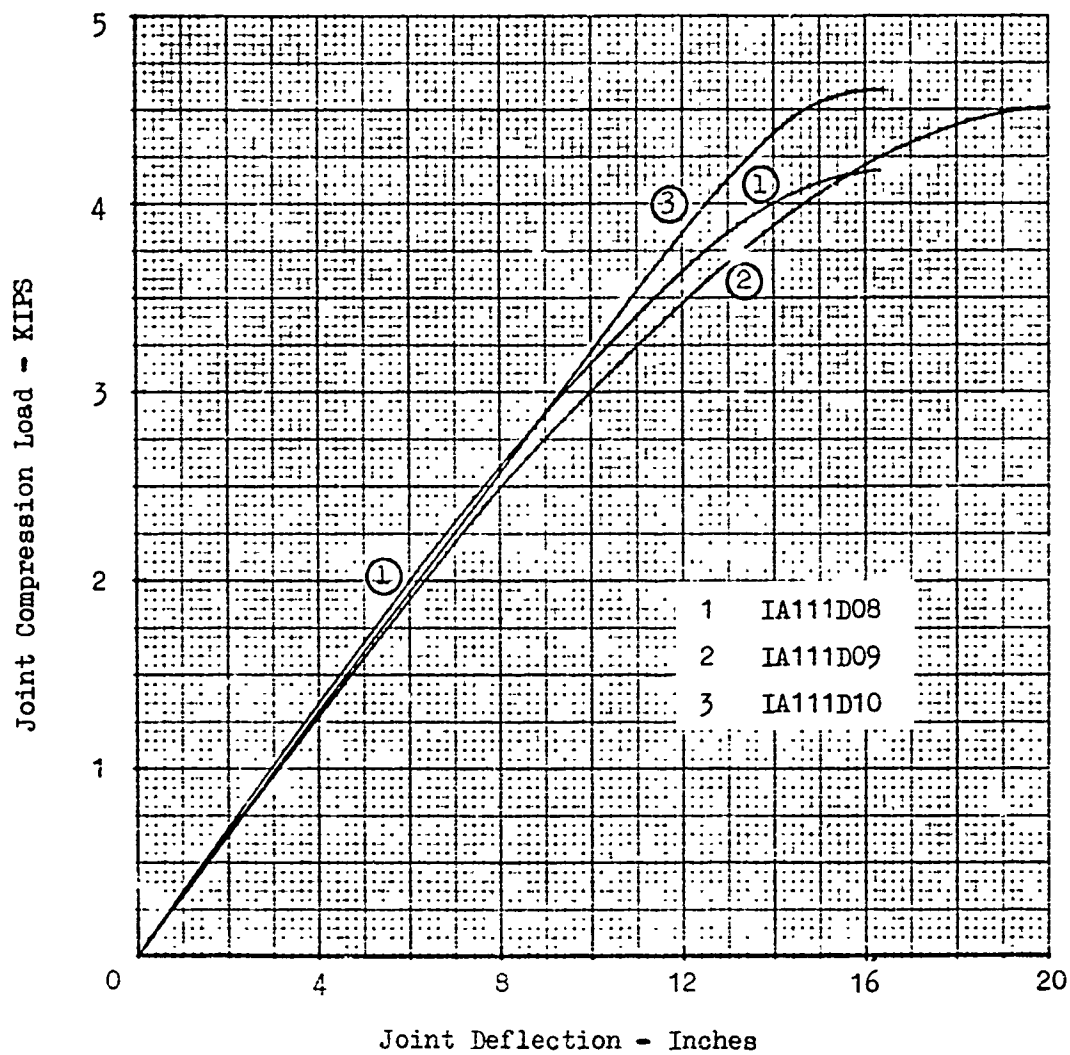


FIGURE 66 JOINT STIFFNESS - STATIC TENSILE TESTS



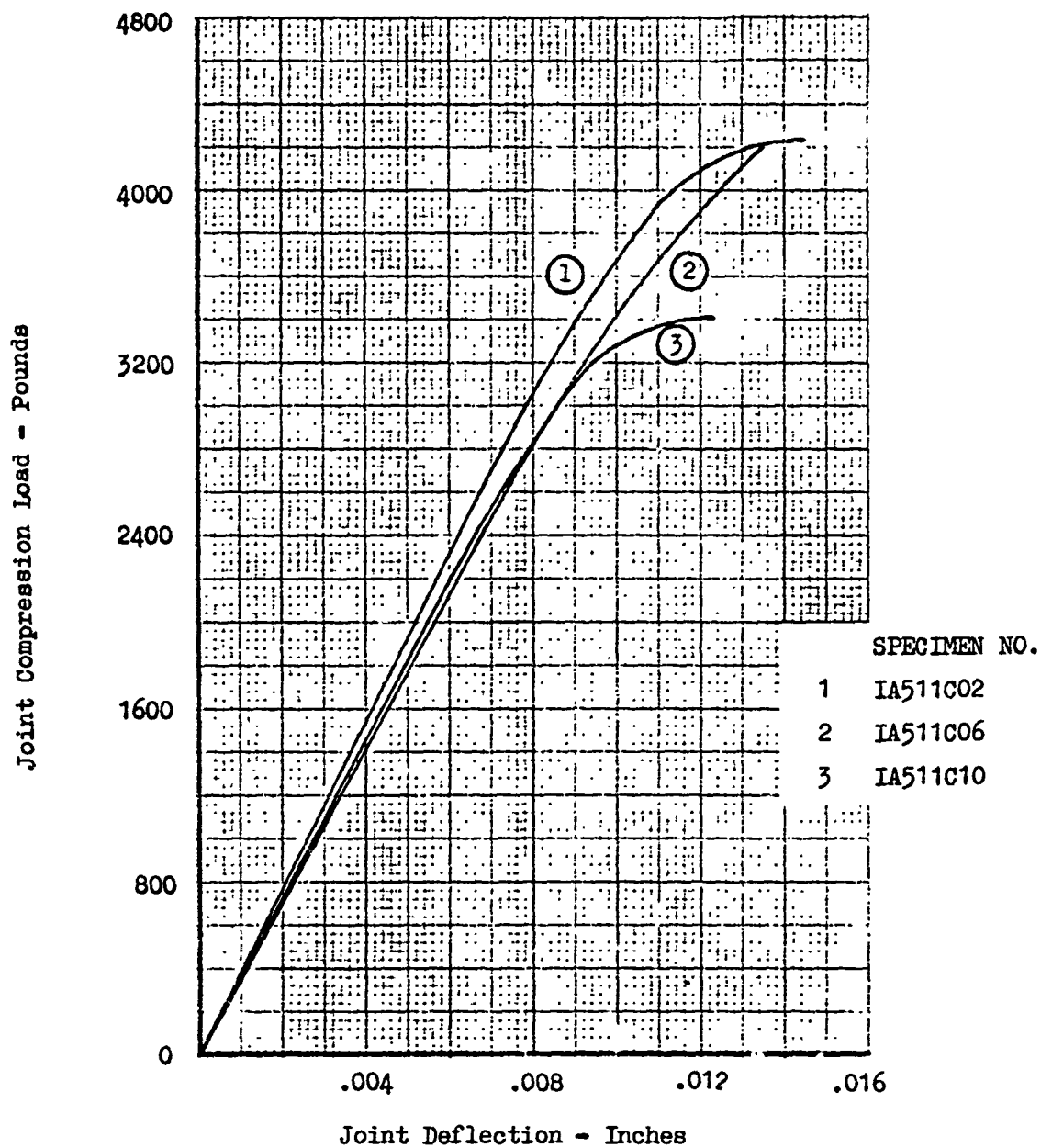
Configuration A
Dwg. No. 7226-1302IA-1A
Gage Length = 2.0"

FIGURE 67 JOINT STIFFNESS - AFTER FATIGUE CYCLING



Configuration A
 Dwg. No. 7226-1302IA-1A
 Gage Length = 2.0"

FIGURE 68 JOINT STIFFNESS - STATIC COMPRESSION TEST



Configuration A
 Dwg. No. 7226-1302IA-1A
 Gage Length = 2.0"

Stress Ratio $R = +10.0$
 Max. Stress 2700 psi
 No. of Cycles 5000

FIGURE 69 JOINT STIFFNESS - AFTER FATIGUE CYCLING

tests were conducted at a stress ratio of $R = +0.1$ and at a stress level of 1400 psi. Results, Appendix B Table B3, indicate that the preload does not significantly affect the fatigue life of the joints.

The graphite-epoxy and glass-epoxy alternate adherend material evaluation tests were conducted in the same manner as the baseline data boron-epoxy tests. The fatigue tests were performed at a stress ratio of $R = +0.10$ and at stress levels that were comparable to those used for the boron-epoxy tests. The results are presented in Appendix B Table B3. S-N curves for all data generated are presented in Volume II of this report. Analysis and comparative studies for all specimen variables are also included in Volume III.

4.5.3 Test Procedure and Results - Phase II

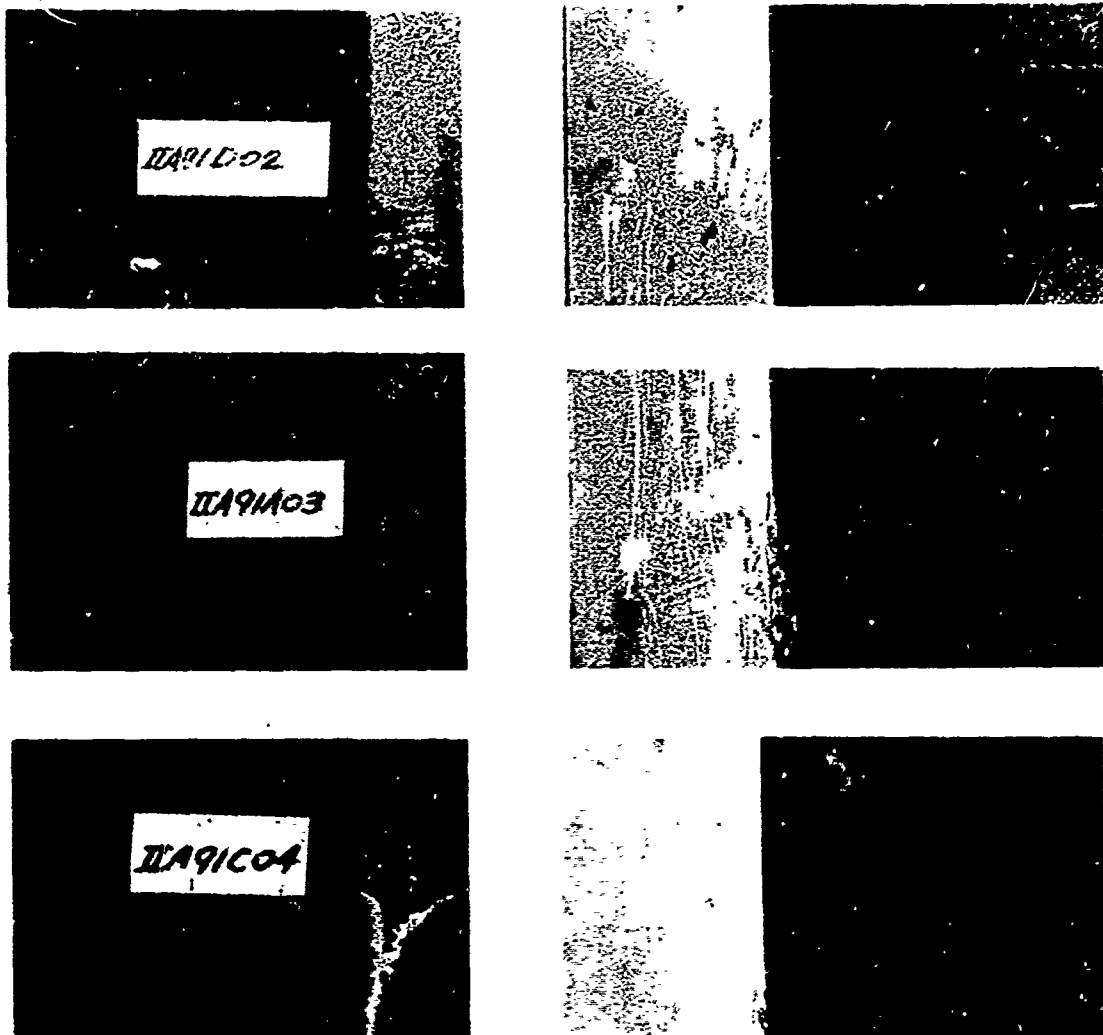
Tests were conducted in accordance with Table IX and the test data are reported in Appendix B, Table IIB1.

The three-inch wide, Configuration A bonded joints were tested using methods similar to those adopted for the appropriate Phase I one-inch wide specimens. Except for the extra width, the support plates were identical to those used on the one-inch wide specimens and the same clearance of approximately 0.003 inch was maintained in the area around the splice plate. The increased width made it necessary to modify the extensometer frame and this was accomplished by utilizing longer connecting straps and longer knife-edged attachments. Some difficulty was encountered with tab failure occurring during the testing of the static specimens. However, satisfactory joint shear strength values were obtained by removing the tab ends and gripping the laminate with a piece of coarse emery cloth between the laminate and grip surfaces. For this method of gripping, the support planes had to be shortened by two inches at each end in order to expose sufficient gripping area. Typical failure modes for the 3.0-inch wide Configuration A specimens are presented in Figures 70, 71, and 72. Static tests resulted in either partial or complete tensile failure of the boron while the $R = +0.1$ fatigue tests resulted in shear failure adjacent to the first ply and partial failure of the surface plies. In analyzing the data obtained from these 3.0 inch wide baseline specimens, as compared with those data generated for similar 1.0-inch wide baseline specimens, a trend is indicated in that there is a loss in joint static shear strength and fatigue life with increase in specimen width, holding overlap length constant. This trend was later extended to the 10-inch width. A similar relationship holds true for the lap length effects data, and the boron-to-aluminum baseline data.



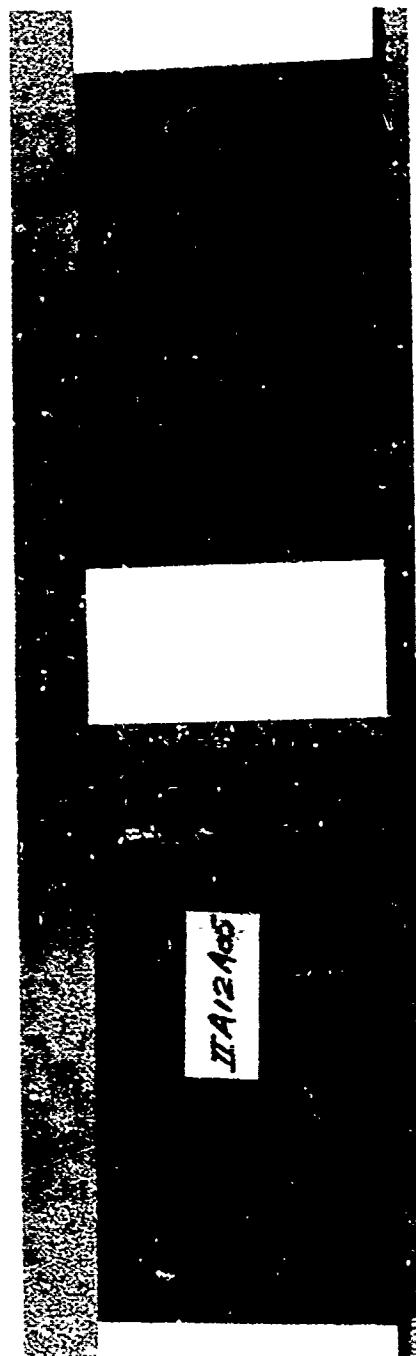
- D02 Typical tensile failure in the boron laminate
- A01 Typical $R = +0.1$ fatigue shear failure adjacent to first ply
- C03 $R = +10.0$ fatigue failure with partial failure of surface plies
- C05 $R = +10.0$ fatigue shear failure adjacent to first ply

FIGURE 70 - CONFIGURATION A - THREE INCHES WIDE
BORON/TITANIUM, BASELINE SPECIMENS



- DQ2 Typical static failure in boron laminate combined with shear adjacent to surface ply
- A03 Typical $R = +0.1$ fatigue shear failure adjacent to first ply
- C04 Typical $R = +10.0$ fatigue failure with partial failure of surface plies

FIGURE 71 - CONFIGURATION A - THREE INCHES WIDE BORON/TITANIUM, LONG LAP LENGTH



-A05 typical $R = + 0.1$ fatigue shear
failure adjacent to the first ply of
boron

FIGURE 72 - CONFIGURATION A - THREE INCHES WIDE
BORON/ALUMINUM BASELINE SPECIMEN

4.5.4 Test Procedure and Results - Phase III

Tests were conducted in accordance with Table IX and the test data were reported in Appendix B, Tables IIIB1. One-inch wide specimens were cut from the edge of the same panel as the 10.0-inch wide specimens and were used for evaluating the static shear strength of the bond. These tests were conducted in the same manner as the Phase I, Configuration A specimens.

The test procedures used for the ten-inch wide Phase III Configuration A joint specimens were similar to those used for the Phase I and Phase II specimens except that the load was introduced through bolted end fittings rather than hydraulic grips. All tests were carried out in an MTS testing machine equipped with steel end fittings, fabricated to the configuration shown in Figure 73. In order to ensure correct specimen alignment in the fittings, a drilling template was used to locate the holes in the specimen ends. Eleven-inch wide lateral support plates were used and a clearance of 0.003 inch was maintained in the joint area. "T" section stiffeners were fastened to the plates to provide the additional support required for the fatigue test at $R = \pm 10.0$. Two thermocouples were bonded to each specimen, one at the edge and the other at the center of the width. A photograph of an $R = \pm 0.1$ fatigue test specimen mounted in an MTS testing machine is shown in Figure 74. Typical failure surfaces of the static control specimens are shown in Figures 75 and 76. Photographs of four 10.0-inch wide specimens after fatigue testing are also shown in Figures 77 thru 80. Two specimens had complete failure across the 10.0-inch width, but the other two specimens had a narrow bond, approximately 2.0 inches along the edge, that did not fail. Generally, the fatigue failure modes were shear adjacent to the surface ply, and this mode appeared to initiate at the center of the joint width and move outward as illustrated in Figures 77 and 78. This theory is strengthened by the fact that the specimens, shown in Figures 79 and 80, did not fail over the complete bond width. The results of the 10.0-inch wide tests indicate that the fatigue capability is further reduced when the specimen width is increased from 3.0 inches to 10.0 inches.

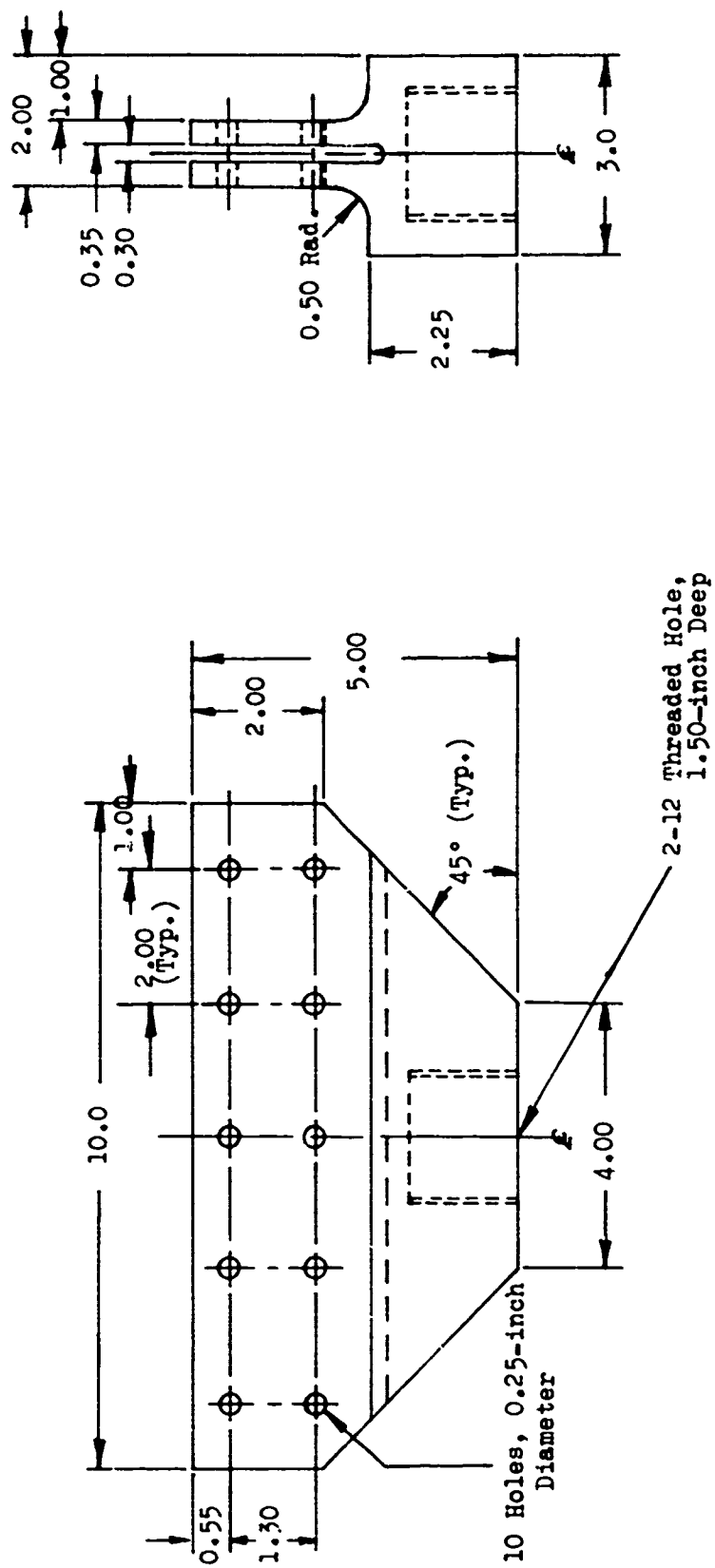


FIGURE 73 . EHD FITTING FOR PHASE III, 10.0-INCH WIDE SPECIMEN

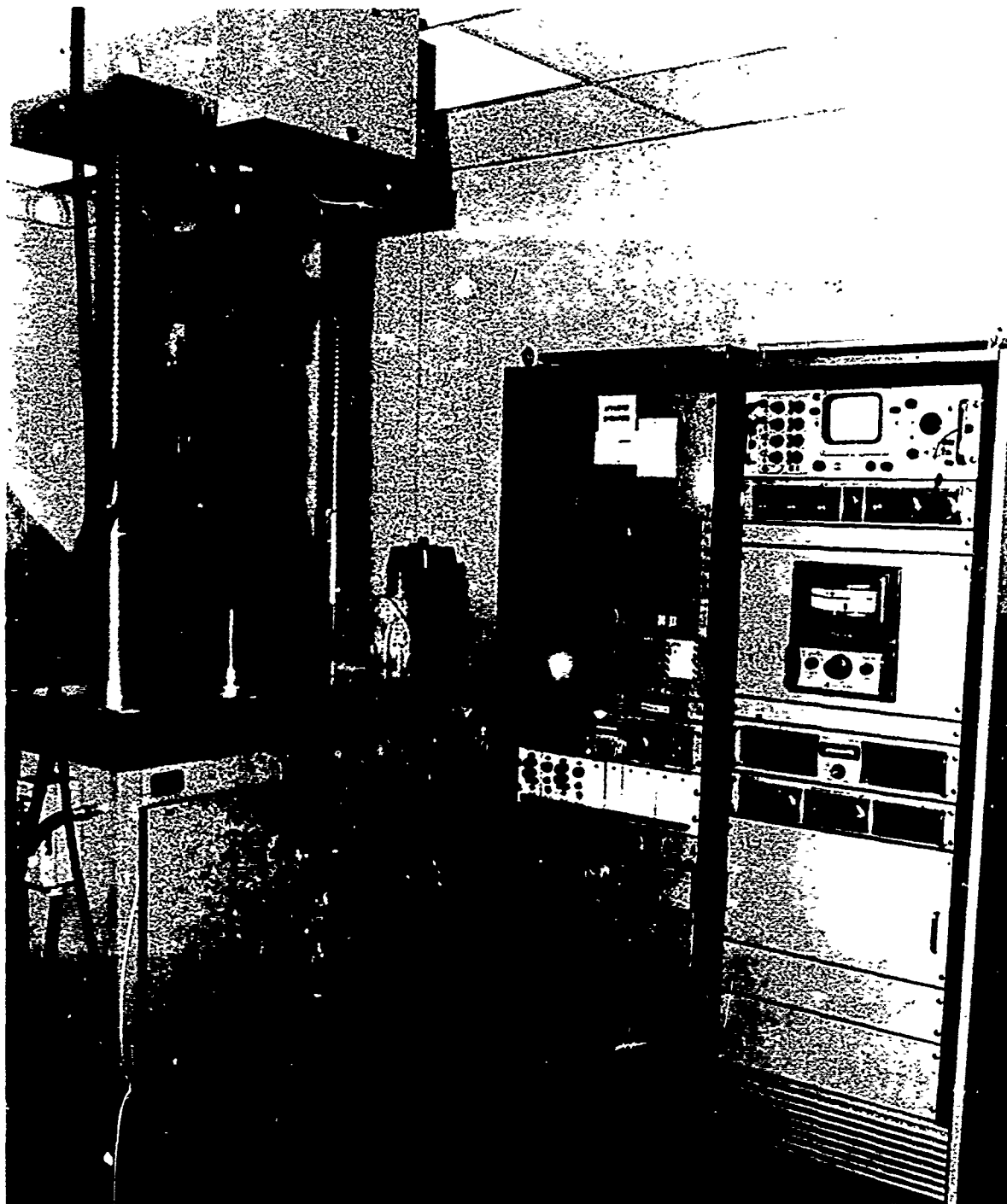


FIGURE 74 - TEST SET-UP FOR TEN-INCH WIDE CONFIGURATION A SPECIMEN

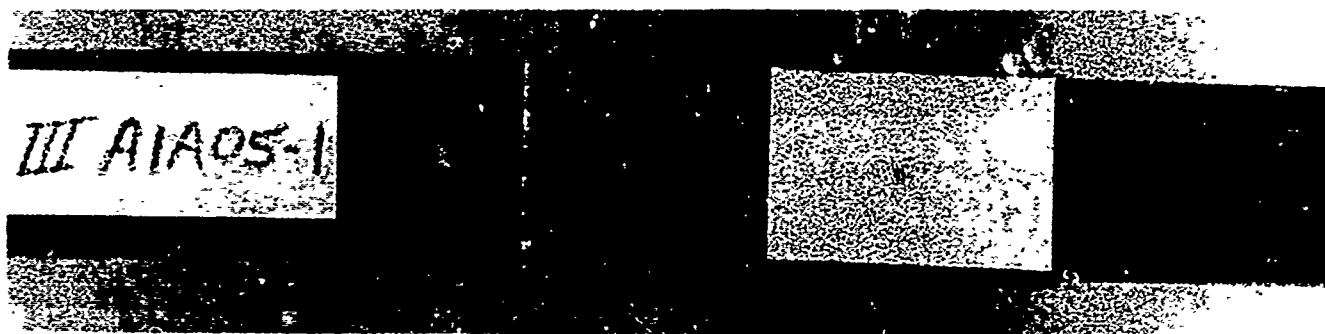


FIGURE 75 - CONTROL SPECIMEN FOR
BORON/ALUMINUM CONFIGURATION A TEN-INCH WIDE SPECIMEN

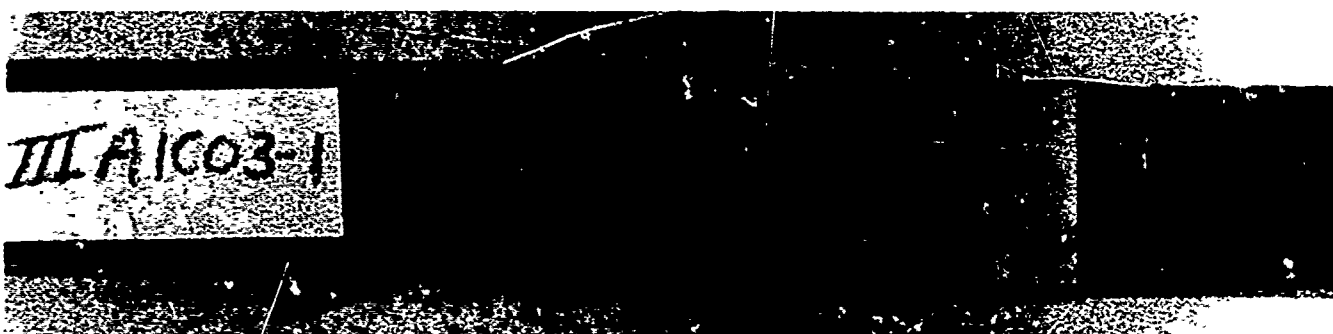
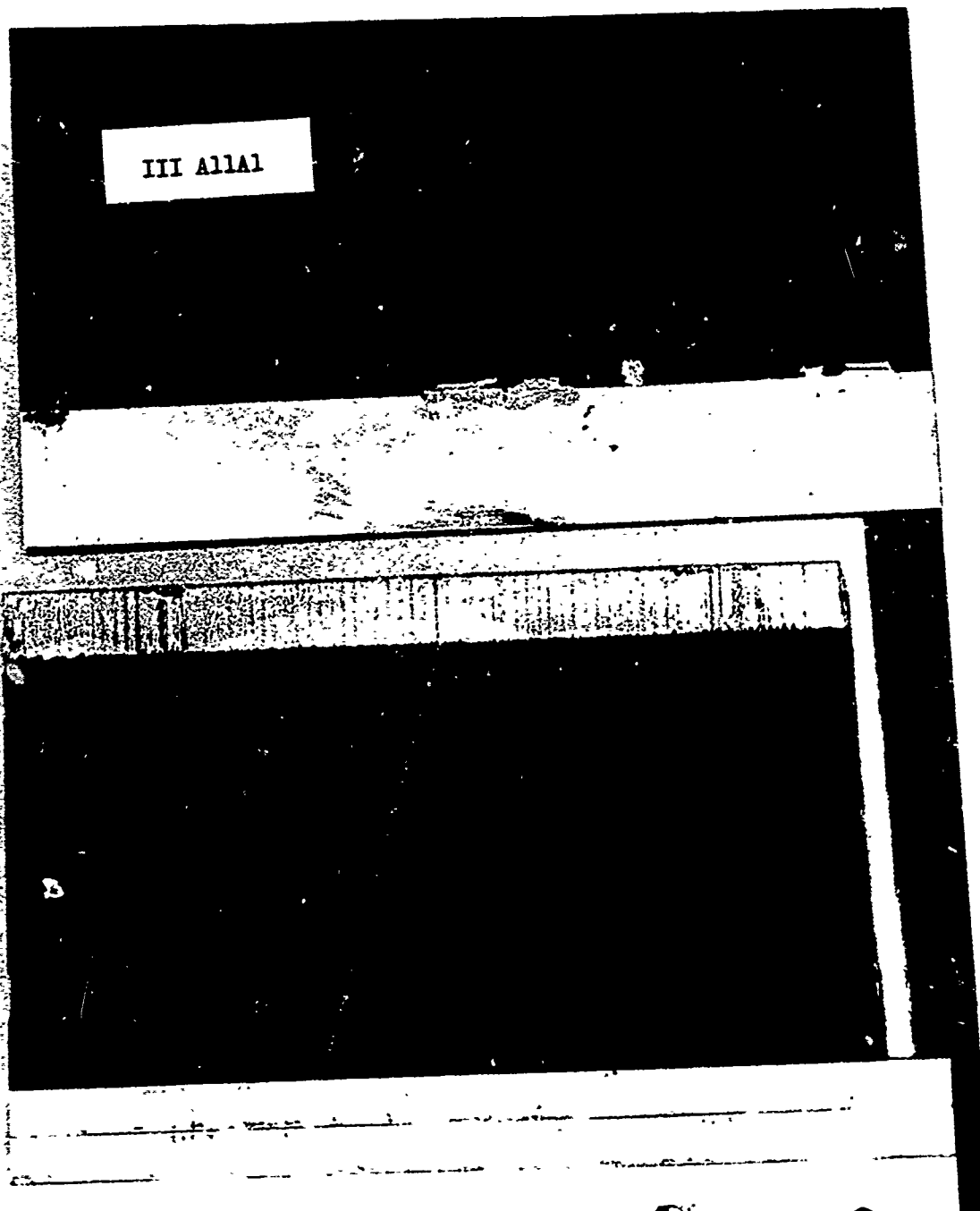
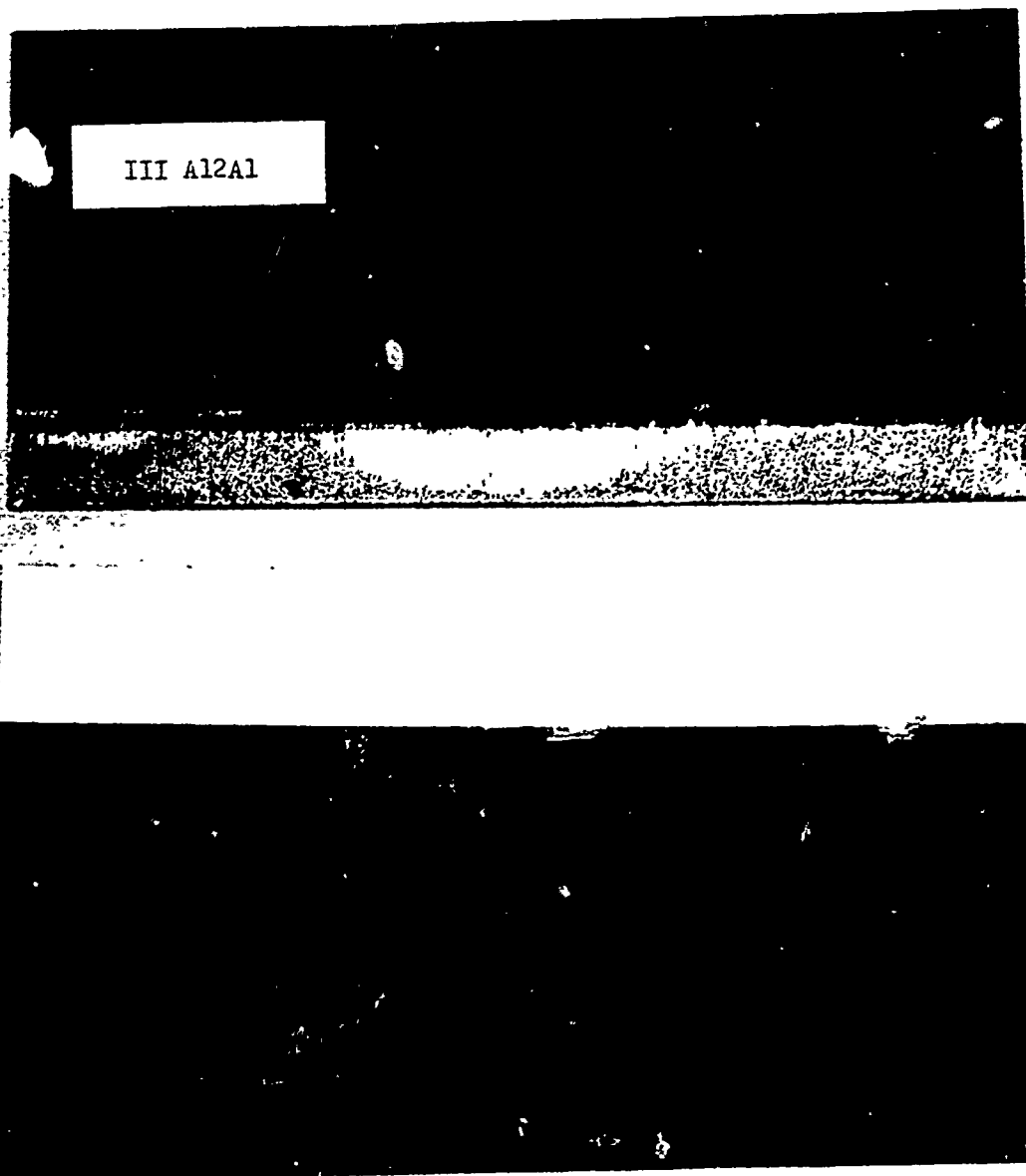


FIGURE 76 - CONTROL SPECIMEN FOR
BORON/TITANIUM CONFIGURATION A TEN-INCH WIDE SPECIMEN



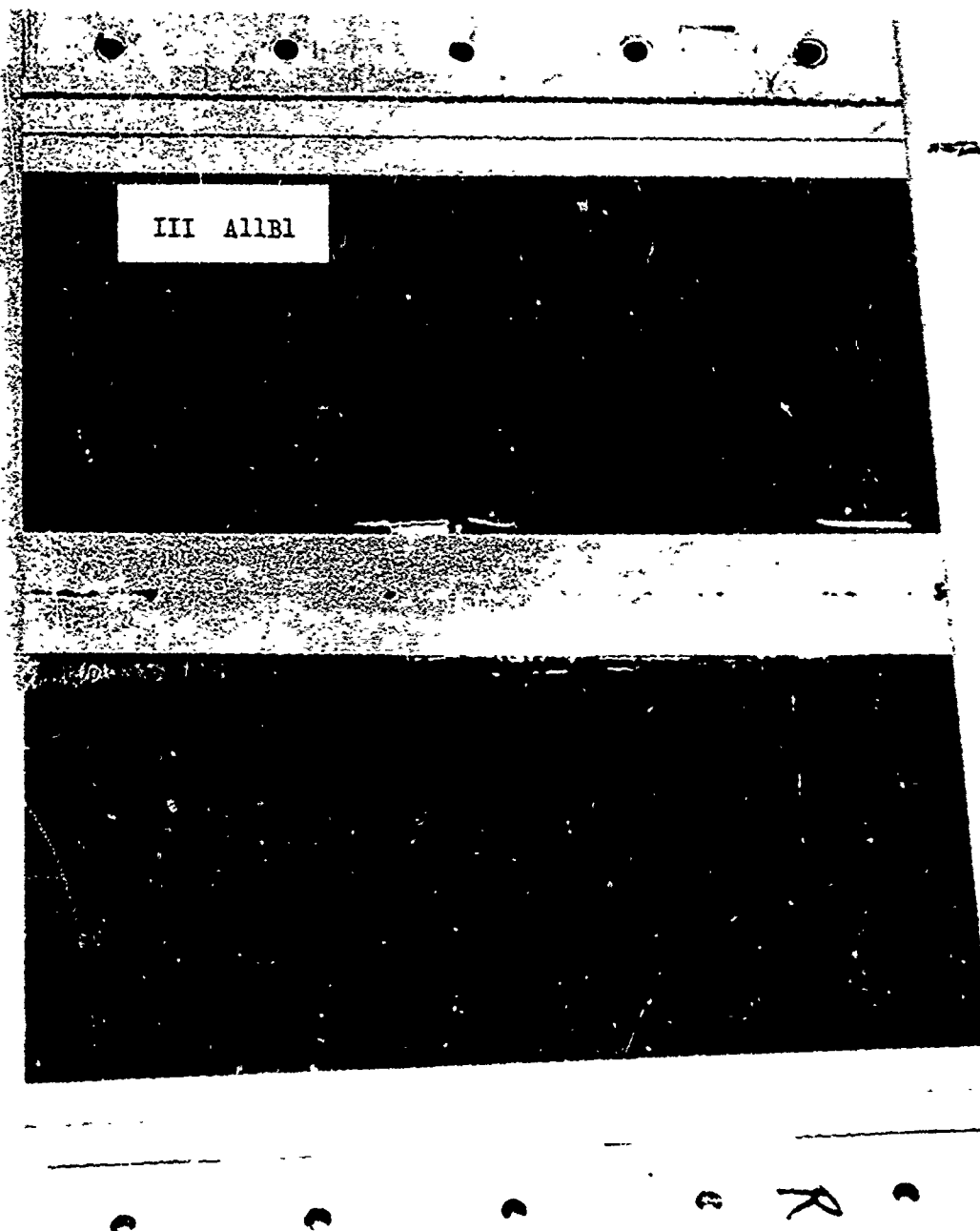
Close examination indicate failure to initiate at the center of the specimen. The splitting of the laminate is probably secondary and due to partial bond failure at the tab end.

FIGURE 77 - CONFIGURATION A - TEN INCHES WIDE
BORON/TITANIUM, STRESS RATIO $R = +0.1$



Fatigue zone can be seen at center of specimen with what appears as static failure towards the edges. Note similarity between these static zones and the static failures of Figure 51.

FIGURE 78 - CONFIGURATION A - TEN INCHES WIDE
BORON/ALUMINUM, STRESS RATIO $R = +0.1$



Fatigue zone can be seen at center of specimen and static zone on the left side and unfailed 2.0" section on the right side.

FIGURE 79 - CONFIGURATION A - TEN INCHES WIDE BORON/TITANIUM, STRESS RATIO $R = -1.0$



Note same failure pattern as shown in Figure 54.

FIGURE 80 - CONFIGURATION A - TEN INCHES WIDE
BORON/ALUMINUM STRESS RATIO $R = -1.0$

4.6 BONDED JOINT TESTS - CONFIGURATION B - STEP LAP SCARF JOINT

4.6.1 Specimen Configuration

The Phase I, Configuration B specimen details are given in Dwg. No. 7226-1302IB, Appendix C. The Phase II and Phase III specimens were fabricated to the same drawing but the width dimension was increased to 3.0 and 10.0 inches respectively. Specimen identification information is given in Tables VII, VIII and IX.

4.6.2 Test Procedure and Results - Phase I and Phase II

The Phase I tests were conducted in accordance with Table VII, and the test data were reported in Appendix B, Tables B10 thru B13. The Phase II tests were conducted in accordance with Table VIII, and the test data were reported in Appendix B, Table IIB2.

All the Configuration B, step lap scarf joints were supported with the same type of plates as those used on the Configuration A joints. The shim plates were modified to provide a cut-out for the thermocouple which was located at the scarf joint interface on the short side of the composite material. This convenient position was selected because a temperature survey utilizing three thermocouples positioned along the length of the joint had indicated that the temperature differential along the joint was negligible for all test stress levels. The gap between the joint and the support plates was maintained at approximately 0.003 inch on each side and over a length slightly greater than the length of the joint, as shown in Figure 81. A "T" section stiffener was added to the support plates when used on specimens that were subjected to compressive loading.

Representative failure modes for a selection of Phase I specimens are presented in Figures 82 thru 85. Typical fatigue failures for the wider Phase II specimens are shown in Figures 86 and 87. Comparison of test data for the 1.0-inch wide joints with the data for the 3.0-inch wide joints shows that a majority of the 3.0-inch wide specimens exhibited longer fatigue lines than did the 1.0-inch wide specimens. This is a reversal of what was shown by a similar comparison for the Configuration A specimens which exhibited shorter

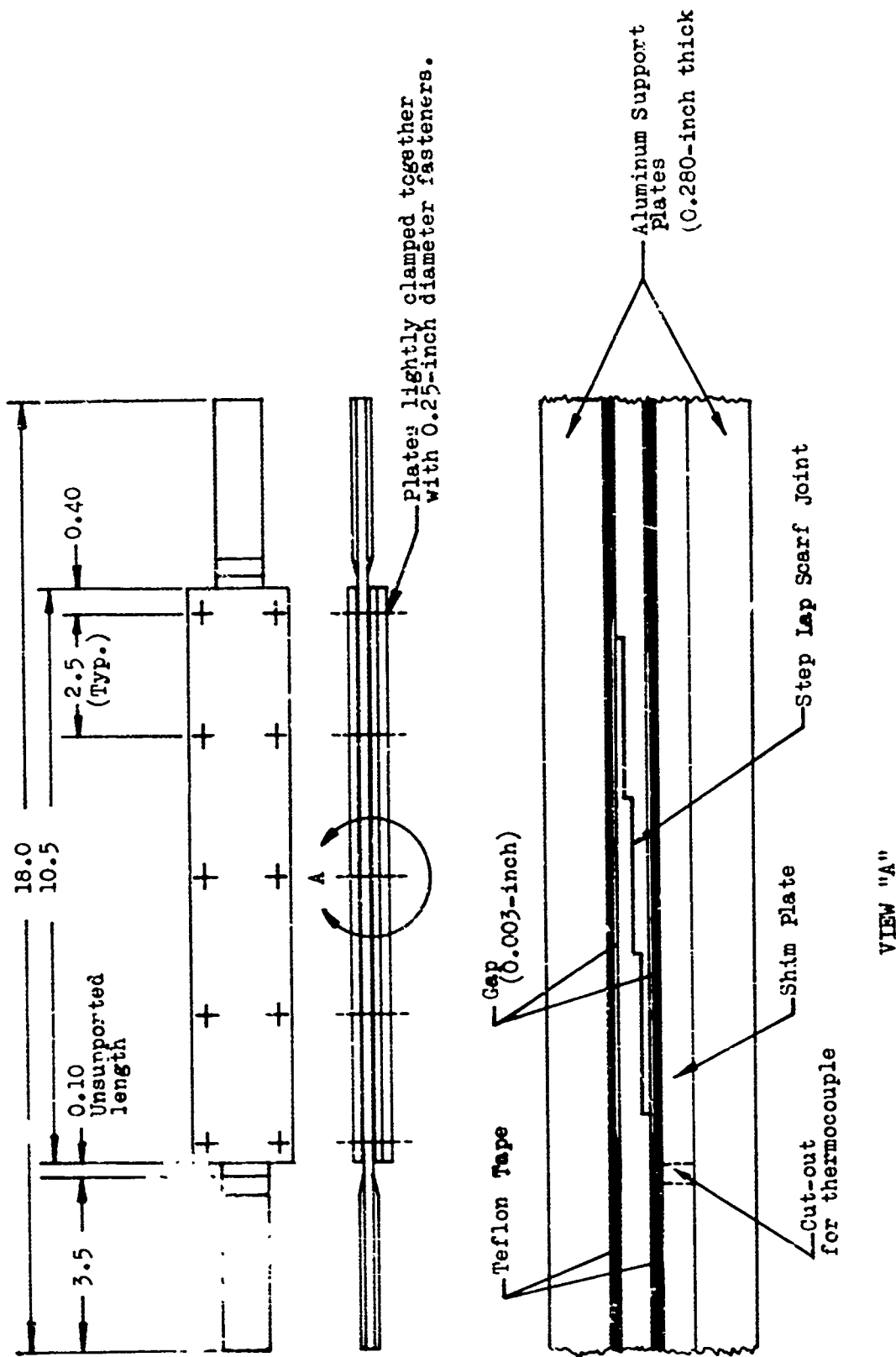
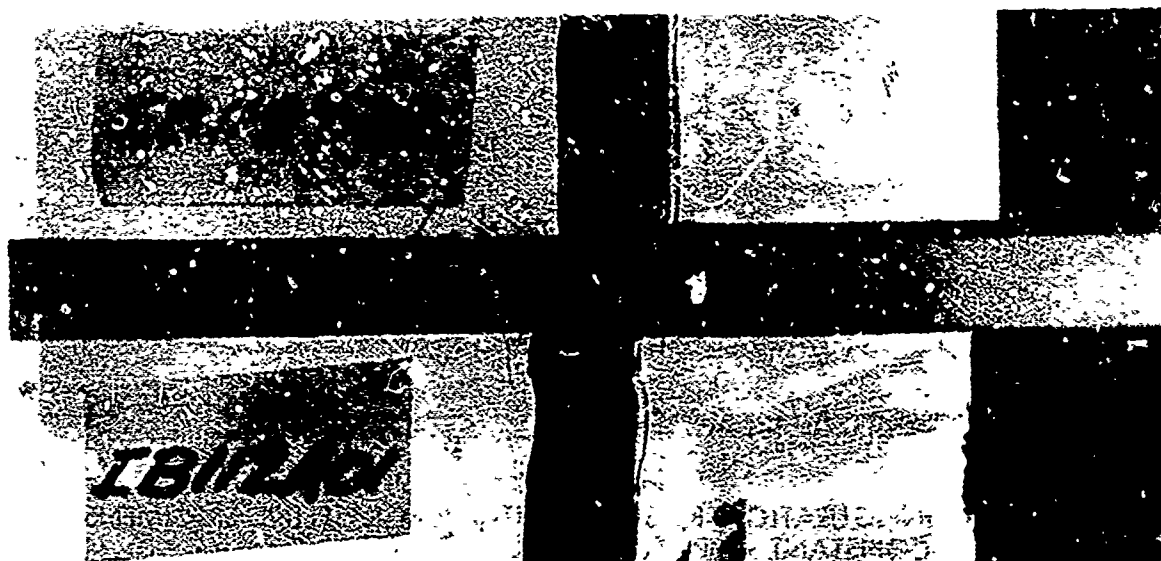
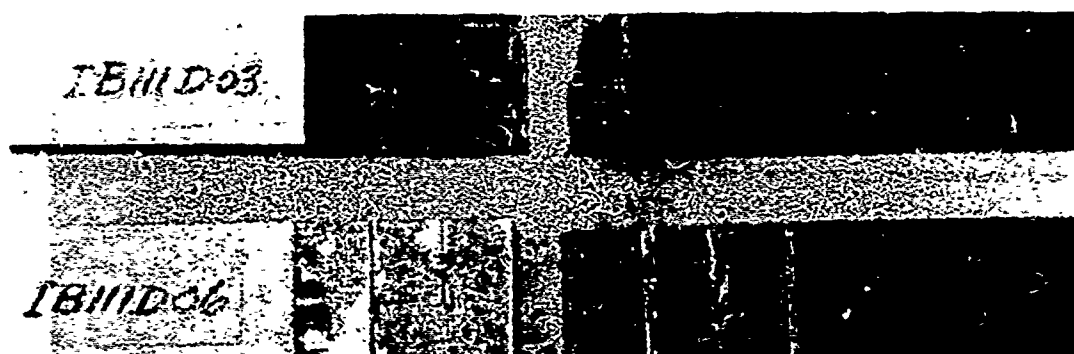


FIGURE 81 SUPPORT PLATE SYSTEM FOR TYPE "B" JOINT SPECIMEN



- D03 Typical static tensile failure in aluminum adherend
- A01 Typical $R = +0.1$ fatigue failure in aluminum adherend

FIGURE 82 - CONFIGURATION B, BORON/ALUMINUM BASELINE SPECIMEN



- D03 Static tensile failure with partial interlaminar shear
- D06 Static tensile shear failure
(mating fracture surfaces are shown)

FIGURE 83 - CONFIGURATION B, BORON/TITANIUM BASELINE SPECIMEN



FIGURE 84 - CONFIGURATION B, BORON/TITANIUM BASELINE SPECIMENS
CONSTANT AMPLITUDE FATIGUE TESTS

- A10 Typical $R = +0.1$ fatigue failure in joint
- C01 Typical $R = +10.0$ fatigue failure in joint with minor laminate damage
(mating fracture surfaces shown)

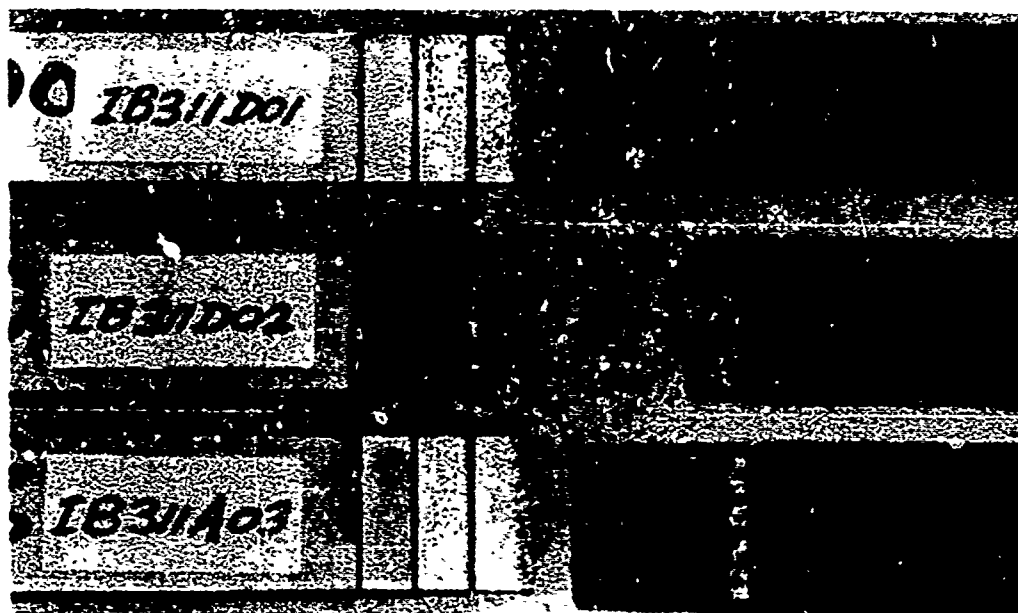
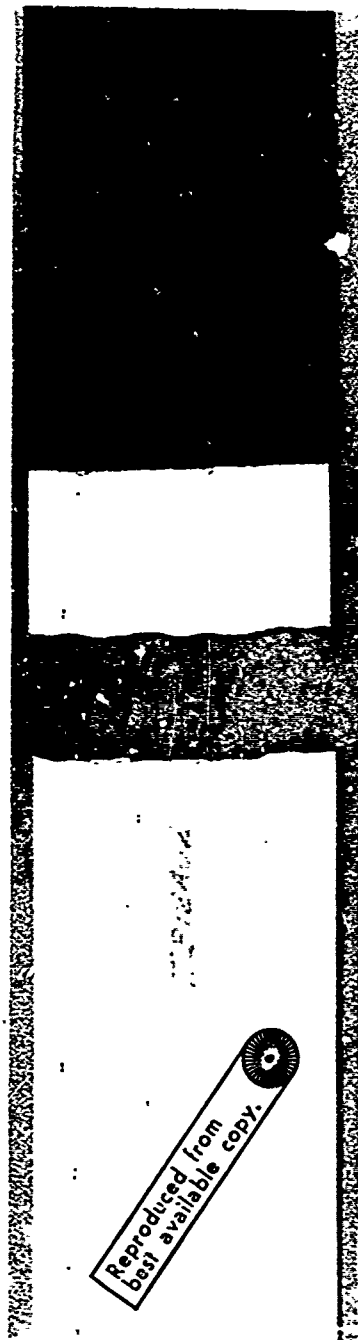


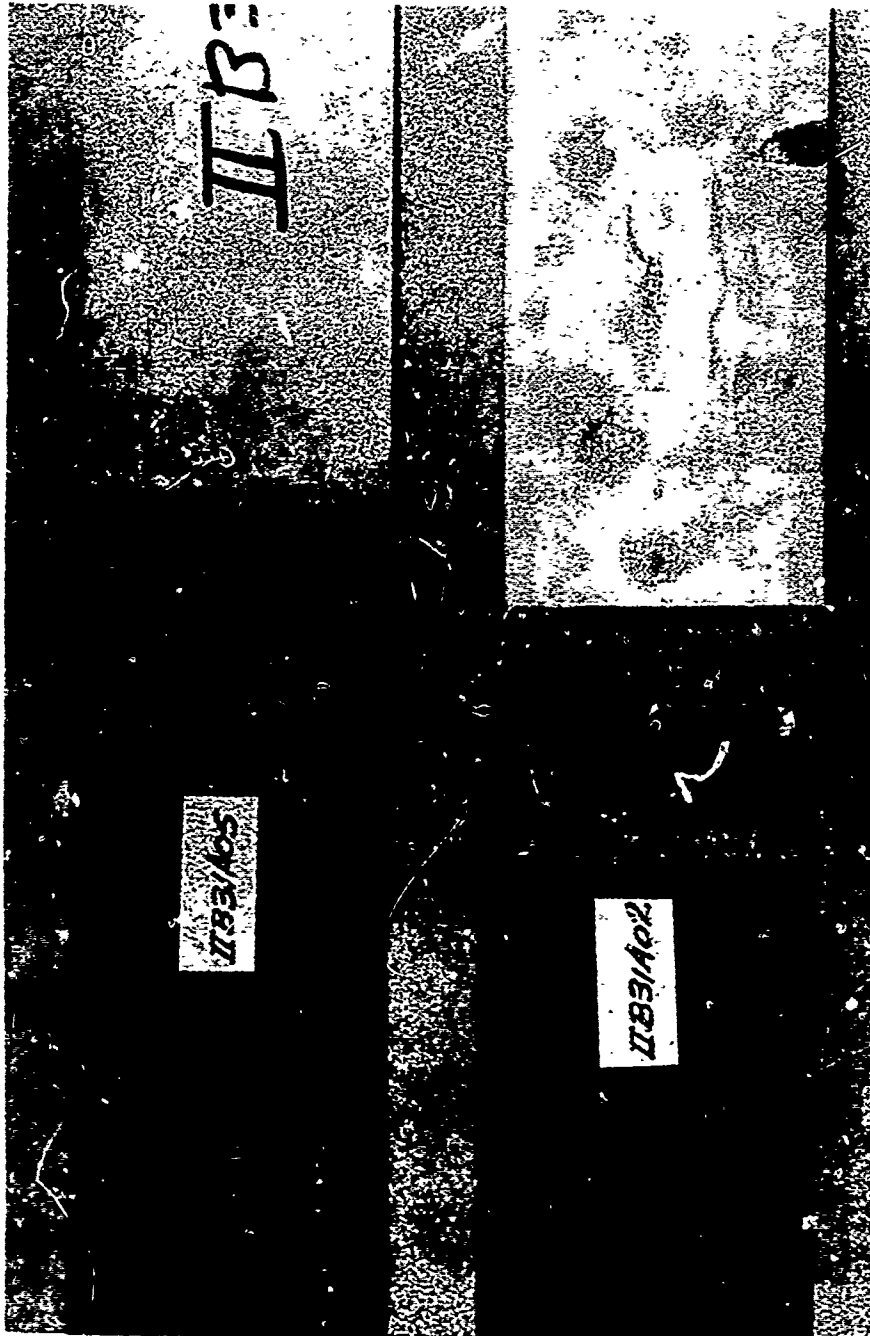
FIGURE 85 - CONFIGURATION B, BORON/TITANIUM SHORT LAP LENGTH

- D01 Static tensile shear failure
- D02 Static tensile failure with partial interlaminar shear
- A03 Typical $R = +0.1$ fatigue failure in joint
(mating fracture surfaces shown)



-A02 Typical $R = +0.1$ fatigue failure in metal

FIGURE 86 - CONFIGURATION B, THREE INCHES WIDE BORON/ALUMINUM,
STEP LAP SCARF JOINT



-A05 R = +0.1 fatigue failure in joint and partial laminate failure
 -A02 R = +0.1 fatigue failure in joint

FIGURE 87 - CONFIGURATION B, THREE INCHES WIDE
 SHORT OVERLAP BORON/TITANIUM, STEP LAP SCARF JOINT

fatigue life with increase in specimen width. The 3.0-inch wide boron-to-aluminum specimens, however, behaved in a more predictable manner due to the mode of failure for this configuration. All failures occurred in the aluminum adherend after approximately the same number of cycles and at the same stress level as did the equivalent 1.0-inch wide step joints.

4.6.3 Test Procedures and Results - Phase III

The Phase III tests were conducted in accordance with Table IX, and the test data are reported in Appendix B, Table IIIB2.

The test procedure used for the ten-inch wide Configuration B specimens was essentially the same as those used for the Configuration A ten-inch wide specimens. A similar support plate system was used but the shim plates were modified to accommodate the different joint configuration. The increase in fatigue life exhibited by the 3.0-inch wide specimens was again exhibited by the ten-inch specimens, i.e., the ten-inch specimens developed longer fatigue life than did the one-inch and three-inch wide specimens.

4.7 BONDED JOINT TESTS - CONFIGURATION C - TEE SUPPORT JOINT

4.7.1 Specimen Configuration

The Phase I, Configuration C specimen details are given in Dwg. No. 7226-13021C, Appendix C, and specimen identification information is given on Table VII.

4.7.2 Test Procedure and Results

Tests were conducted in accordance with Table VII, and the test data are reported in Appendix B, Table B14.

A specially designed support and side loading fixture was used for all tests. The fixture was fabricated to the configuration shown in Figure 88 and consists of two lateral support plates with two stiffener plates attached to one of the lateral plates. The same plate has a cut-out at the center to allow the tee piece of the specimen to pass through. A strain-gaged link, in the form of a fork-end with a threaded shank, is attached to the tee and the threaded end passes through a reaction plate mounted to the stiffener plates. Originally a coil spring was located between the reaction plate and the end of the shank of the link and was held in place by a nut and washer. Later developments, however, resulted in the coil spring being replaced by two pieces of 0.125 inch thick rubber sandwiched between the reaction plate and a large 0.10 inch thick aluminum washer. Load was applied to the tee by turning the nut on the calibrated strain-gaged link. The magnitude and shape of the lateral deflection along the length of the specimen adherend is controlled by the type of shimming used between the specimen and the support plates, and by the magnitude of the applied axial load. After evaluating various systems it was found that a tapered aluminum shim and soft rubber sheet combination provided the desired deflection pattern. The aluminum shims were 0.150 inch thick at the tab end and feather-edged at the other end near the tee. The soft rubber was approximately 0.50 inch thick and the same length as the shim. One piece of rubber and one shim were sandwiched between the specimen adherend and the upper support plate on each side of the tee joint.



1. *Staphylococcus aureus* (100%)

The static tests were conducted by maintaining a selected axial load on each specimen and then determining the side load required to fail the tee-to-specimen bond. The selected axial loads were representative of the range anticipated for the fatigue tests. The test set-up for the fatigue tests is shown in Figure 89. After the mean axial load had been applied to the specimen, the side load (based on the results of the static tests) was applied to the tee. A typical test specimen with mean axial and side loads applied is shown in Figure 90. Application of the dynamic axial load caused a variation in the side load which was monitored on the calibrated stripchart recorder. Each specimen had a thermocouple bonded to the adherend at the edge of the tee. Failure of the bond between the tee and boron resulted in a straightening of the boron adherend which in turn triggered the micro-switch and stopped the machine.

A photograph of a failure specimen immediately prior to failure is presented in Figure 91.

Failures generally occurred in the resin adjacent to the fibers in the surface ply as illustrated in Figures 92 and 93. One fatigue specimen, however, had an unusual failure mode as shown in Figure 94. This specimen had a partial tensile failure in the boron resulting in interlaminar shear failure over a large portion of the laminate.

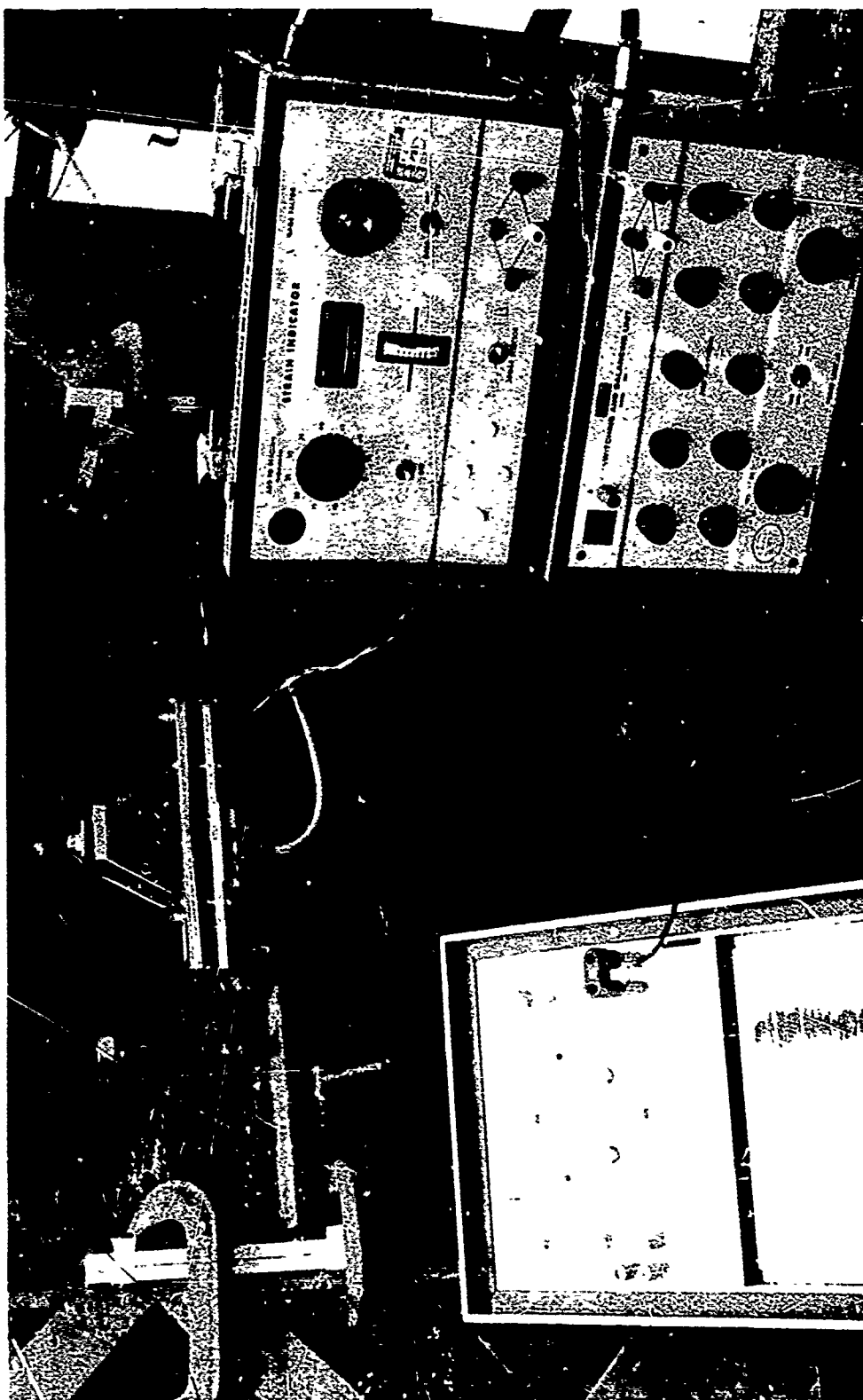


FIGURE 89
Test Fixture For Configuration C Bonded Tee Joint

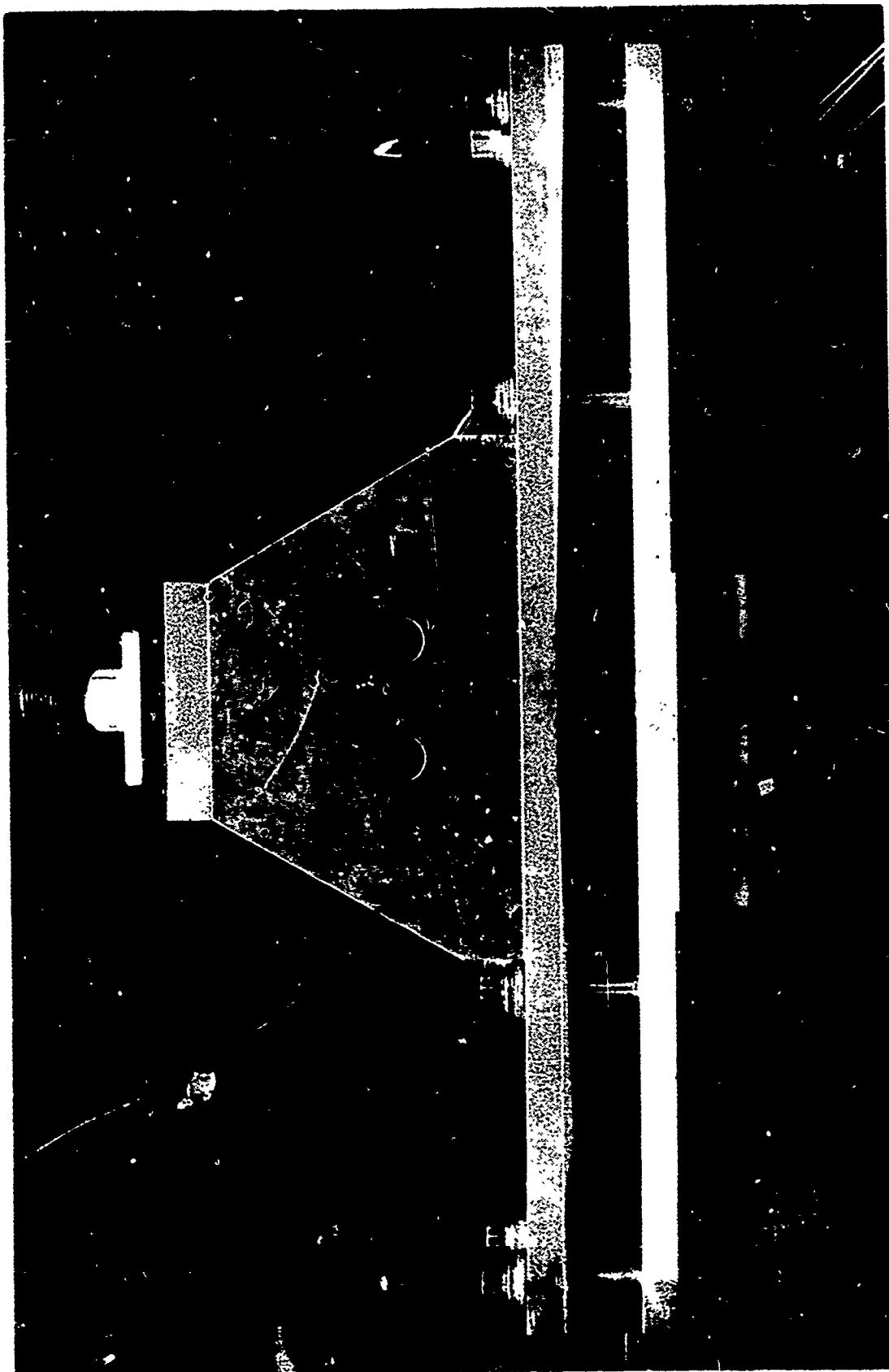


FIGURE 90
Test Set-Up for Configuration C Specimen (Mean Axial and Side Loads Applied)



FIGURE 91
Configuration C Specimen Under Fatigue Loading Just Prior to Failure



Figure 92 Configuration C, Titanium Tee/Eoron Static Test



Figure 93 Configuration C, Titanium Tee/Eoron
Fatigue Test R = +0.1 Typical Failure



Partial tensile failure and interlaminar shear

FIGURE 94 - CONFIGURATION C, TITANIUM TEE/BORON
FATIGUE TEST $R = +0.1$

4.8 CONFIGURATION D - DOUBLE JOINT TESTS

4.8.1 Specimen Configuration

Details of the Configuration D specimen are given in Drawing No. 7226-1302ID, Appendix C. Specimen identification information is given on Table VII.

4.8.2 Test Procedure and Results

Tests were conducted in accordance with Table VII, and the test data are reported in Appendix B, Table B15 and B16.

Since the double strap joints of the Configuration D specimens were balanced, lateral support plates were not necessary. Specimen temperature was measured with a thermocouple bonded to the adherend adjacent to the end of a splice plate. In all other respects the test procedures were similar to those used for the Configuration A specimens. Static and fatigue failure modes for the titanium splice plate specimens are shown in Figures 95 and 96. The catastrophic failure shown in Figure 95 was typical for all static tests. Failure modes for the boron splice plate specimens are shown in Figure 97. Static test specimens failed in tension across the splice plates, but the fatigue specimens failed in shear at the joint similar to the fatigue failures for the titanium splice plate specimens. Test results for these Configuration D specimens were comparable to the results obtained with the baseline Configuration A specimens. This close comparison verifies that the support plates used with the Configuration A specimens provided just the correct amount of support to the joint area. This permits all Configuration A and D data to be used in conjunction with the analysis procedures discussed in Volume I of this report.



Figure 95 Configuration D, Boron/Titanium, Static Test
Titanium Splice Plates

-D03 Typical static tensile failure

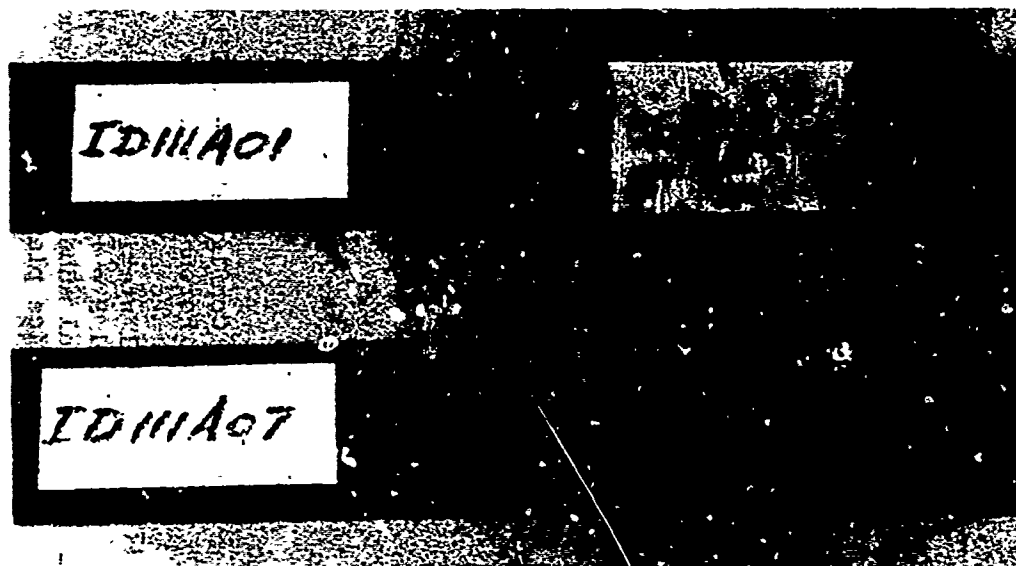


Figure 96 Configuration D, Boron/Titanium, Fatigue Tests $R = +0.1$
Titanium Splice Plates

-A01 Failure between boron and both splice plates on one end
-A07 Failure of one splice plate at both ends and failure of other
splice plate at one end

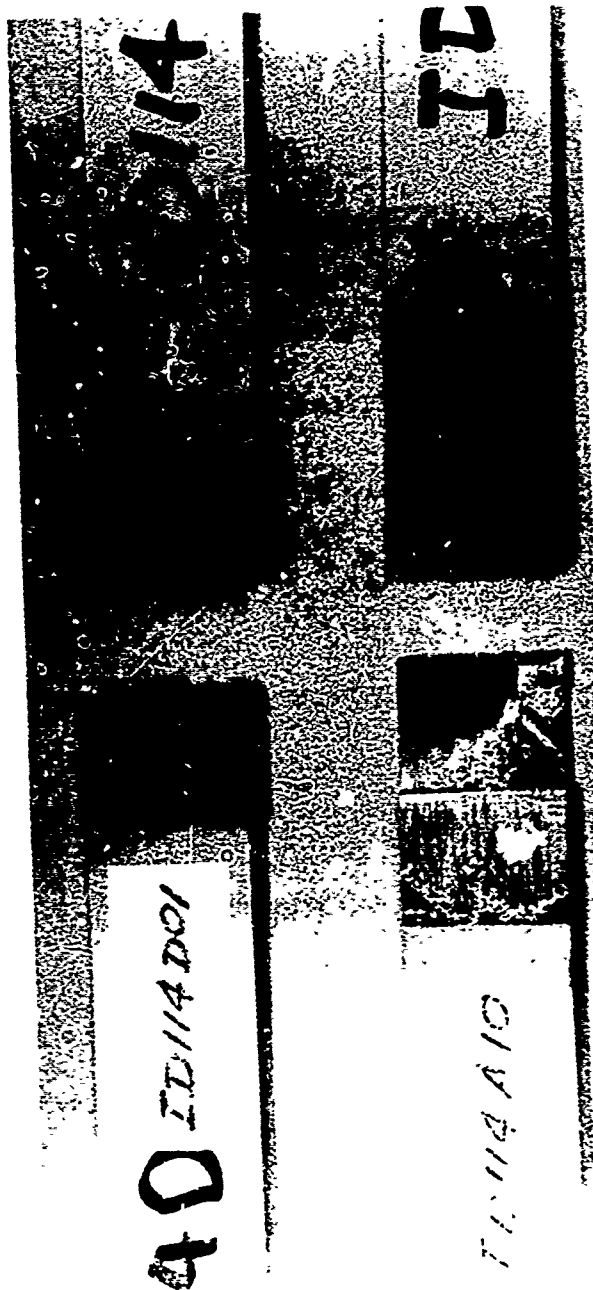


Figure 97 Configuration D, Titanium/Boron Static and Fatigue Boron Splice Plate

-DO1 Typical static failure-net section in splice plate
 -A10 Typical $R = +0.1$ fatigue failure shear failure in ply adjacent to metal adherends. Fatigue damage can also be seen at center of splice plate

4.9 BONDED JOINT-CUMULATIVE DAMAGE TESTS

4.9.1 Specimen Configuration

One-inch and three-inch wide Configuration A specimens were fabricated for the Phase I and Phase II cumulative damage tests. A ten-inch wide, modified Configuration A specimen and a ten-inch wide, modified configuration B specimen were fabricated for the Phase III cumulative damage tests.

4.9.2 Test Procedure and Results

Phase I tests were carried out in accordance with Table VII, and the test data are reported in Appendix B, Table B3. Phase II tests were carried out in accordance with Table VIII, and the test data are reported in Appendix B, Table IIB1. Phase III tests were carried out in accordance with Table IX, and the test data are reported in Appendix B, Table IIIB.

The cumulative damage tests were conducted using the same support plate systems that were selected for the appropriate baseline data specimens tested in each of the three Phases. The same programming equipment was used for all testing and is described in detail in section 4.2.3. Two software programs were used to prepare the computer for either block loading format or realistic loading format. Both types of loading programs are described in Volume III, Section 2.3.

During the testing of the Phase I specimens, some failures occurred in the adherend material between the end of the support plates and the tab end of the specimen. The cause of these premature failures was not determined. However, sufficient contingency specimens were available to complete the required number of cumulative damage tests with valid joint failures. The maximum and minimum load levels of each individual block were measured on the MTS load amplitude measurement equipment in addition to being continually monitored on a calibrated Clevite-Brush strip-chart recorder. Correlation between the two load measuring systems was very good and since the MTS measuring

equipment cannot measure single load levels the strip-chart recorder was used for determining the actual applied loads for the realistic spectrum testing. A typical strip-chart recording showing all the load levels in each of four different missions is shown in Figure 98. A one "g" value that corresponded to a joint shear stress of 330 psi was used for both the block and realistic spectrum loading in Phase I.

Since only five cumulative damage tests were scheduled in Phase II it was not possible to use both types of loading spectrum. The realistic spectrum loading was finally selected since it was believed that this type of loading would produce the most useful test data. Three specimens were tested at a one "g" value that corresponded to a joint shear stress of 290 psi and the other two at a joint shear stress of 260 psi.

The Phase III, 10.0-inch wide specimens were tested using the block loading spectrum adopted originally for the Phase I bonded joint tests. Both the Configuration A and Configuration B specimens were loaded to a maximum average joint shear stress level of 2000 psi (10 "g" load level). The same stress level was selected for each test because it was believed that the results would provide useful comparative damage data in the two joint configurations. Good failures were obtained from both tests, the Configuration A specimen failed after 2.5 lifetimes (25 blocks) and the Configuration B after about 6.1 lifetimes.

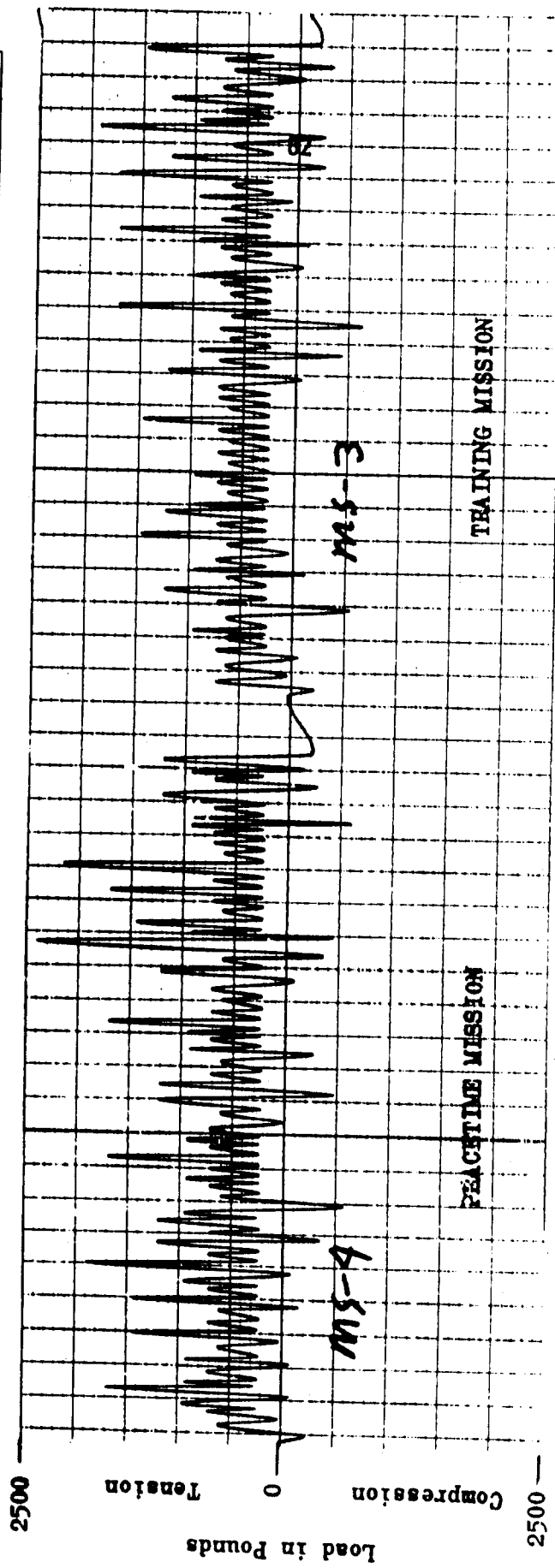
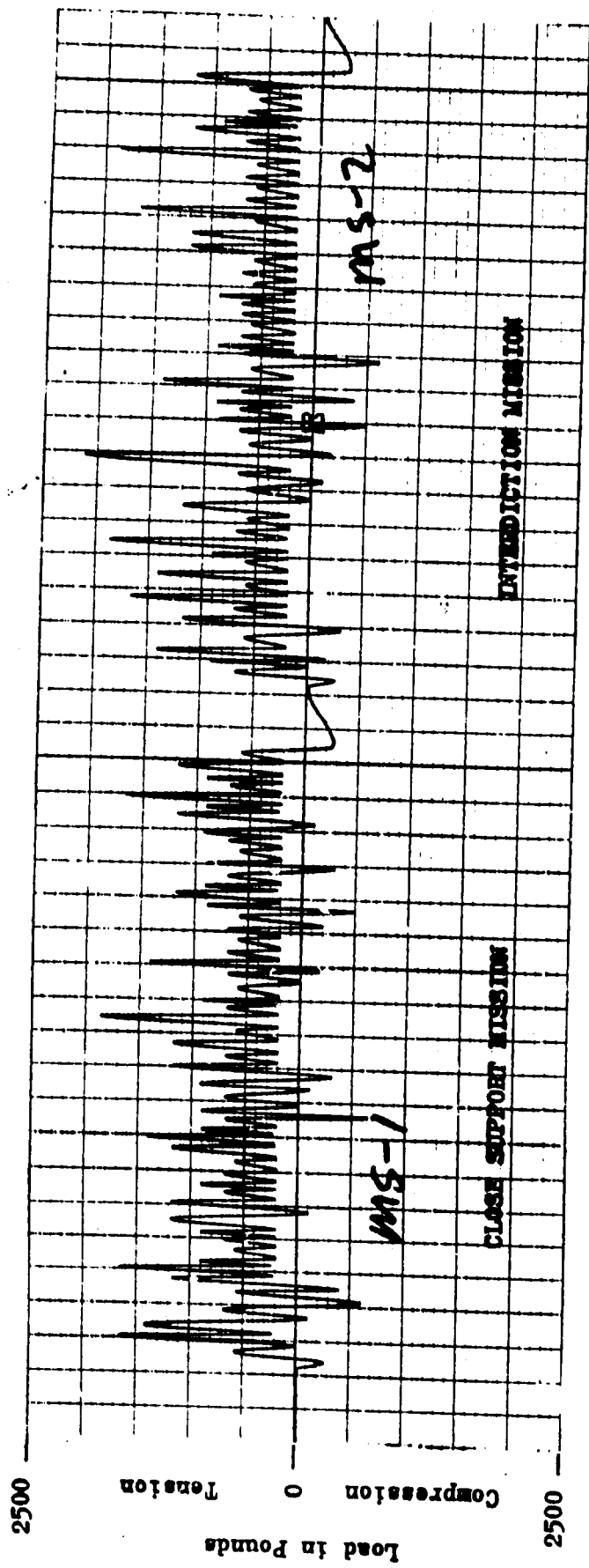


FIGURE 98 TYPICAL STRIP-CHART RECORDING OF INDIVIDUAL LOAD LEVELS IN EACH MISSION, REALISTIC LOAD SPECTRUM

4.10 MECHANICAL JOINT TESTS - CONFIGURATION E - SINGLE SPLICE BUTT JOINT

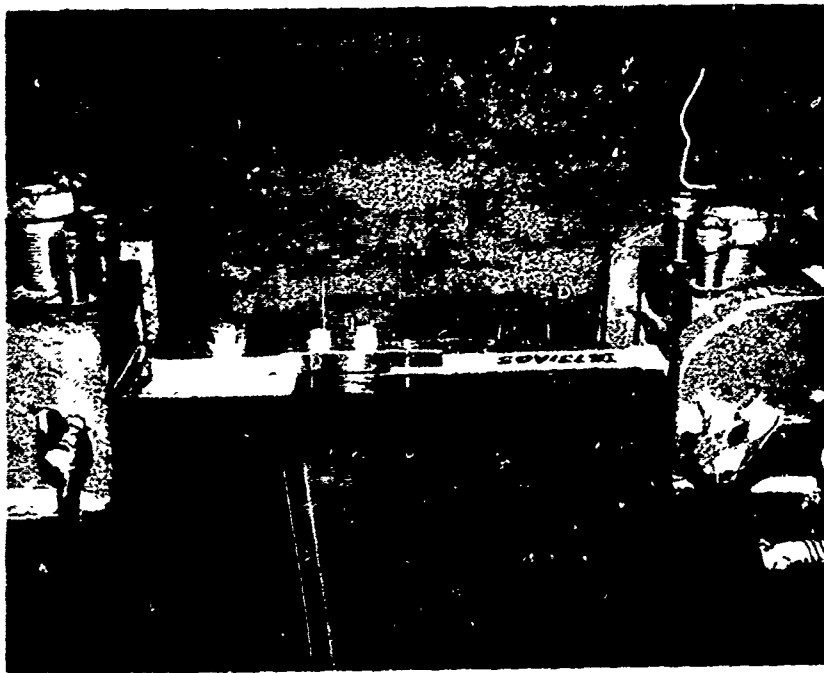
4.10.1 Specimen Configuration

Phase I, one-inch wide and Phase II, 2.0-inch wide specimen details are given in Dwg. No. 7226-1302IE, Appendix C. Specimen identification information is given on Table X.

4.10.2 Test Procedure and Results

The tests were conducted in accordance with Table X and the test data are reported in Appendix B, Table IVB1 thru IVB4.

Pin bearing static strengths were determined in a universal testing machine and all fatigue tests were conducted in Lockheed designed fatigue machines. The same pinbearing test fixture was used for all tests. This fixture is shown in a typical fatigue test set-up in Figure 99. It consisted of two steel bars, one clamped on each side of the end of the test specimen, and load was introduced to the specimen through a 0.187 inch diameter steel pin. During each static test, hole deformation was measured with a 2.0-inch gage length extensometer. One pair of the extensometer knife edges were attached to the edges of the specimen in line with the pin loading hole and the other pair of knife edges were attached to the test fixture. Load versus deformation was plotted on an autographic recorder. Since there were only five fatigue specimens within a group, one specimen was fatigue tested at each of five different stress levels. Photographs of typical failures are presented in Figures 100, 101, and 102. The test data were exceptionally consistent enabling good fatigue trend lines to be determined for the different specimen configurations. Data generated included the evaluation of a $0^\circ/\pm 45^\circ$ reinforced with titanium shims and with additional $\pm 45^\circ$ plies. The effect of edge distance was also evaluated with the specimens using titanium shims as the reinforcement material in the joint area.



(General View)



(Close-up View)

Figure 29 Pin Bearing Test Set-Up



Figure 100 Pin Bearing Specimen ($0^\circ/+45^\circ$)
Titanium Reinforced, $e/D = 2.0$
-D02 Typical Static Failure
-A02 Typical $R = +0.1$ Fatigue Failure



Figure 101 Pin Bearing Specimen ($0^\circ/+45^\circ$)
Titanium Reinforced, $e/D = 1.5$
-D03 Typical Static Failure
-A04 Typical $R = +0.1$ Fatigue Failure

Originally, the Configuration E single splice butt joint specimens were fabricated with aluminum straps and splice plates but initial testing of these resulted in premature failures of the aluminum at the joint net sections. It was assumed that failure may have been encouraged by the countersink in the aluminum strap, therefore testing of these specimens was discontinued to allow further investigation. Two specimens were reassembled with titanium straps having the same type of flush head fastener. Premature failures still occurred at the net section of the titanium portion of the joint and the subsequent substitution of protruding head fasteners still did not produce the required boron failures. However, the final design discussed in the Fabrication Section was tested and acceptable failures were obtained in the boron material. All the mechanically fastened joint specimens were tested in the same testing machines that were used for the bonded joint specimens and a similar support plate system was used. Holes were cut in the support plates to accommodate the fastener collars and the gap between the support plates and the specimen in the splice area was maintained at approximately 0.003 inches. The specimens were supported at equal distances on each side of the joint as shown in Figure 103. The actual distance for a given group of specimens was determined by the length of the tapered section in the boron composite where the titanium shims were inserted. Allen wrenches were placed in the ends of the fasteners in order to detect any rotation of the collars or fasteners during fatigue testing. A typical fatigue test set-up with allen wrenches in position and with each location marked in relation to the support plates is shown in Figure 104. Each collar position was also marked relative to the wrench position. Numerous tests confirmed that no rotation had occurred in either the fasteners or collars therefore the procedures adopted for determining rotation were discontinued. Selection of the stress levels for the fatigue tests was based on the results of the pinned joint/edge distance evaluation tests. Excessive heating (over 10° Fahrenheit rise above ambient) was experienced during the initial fatigue testing but effective control was obtained by blowing cool air over the joints with the arrangement shown in Figure 105. Photographs of typical failures are presented for the 1.0-inch wide specimens in Figures 106 thru 111 and for the 2.0-inch wide specimens in Figures 112 and 113. Failures for specimens tested at a stress ratio of $R = +0.1$ usually occurred in the net section area of the shimmed boron through a fastener hole, or at the edge of the shim reinforcement in the basic boron laminate; however, one failure occurred in the titanium splice plate. This splice plate failure suggests that the shimmed

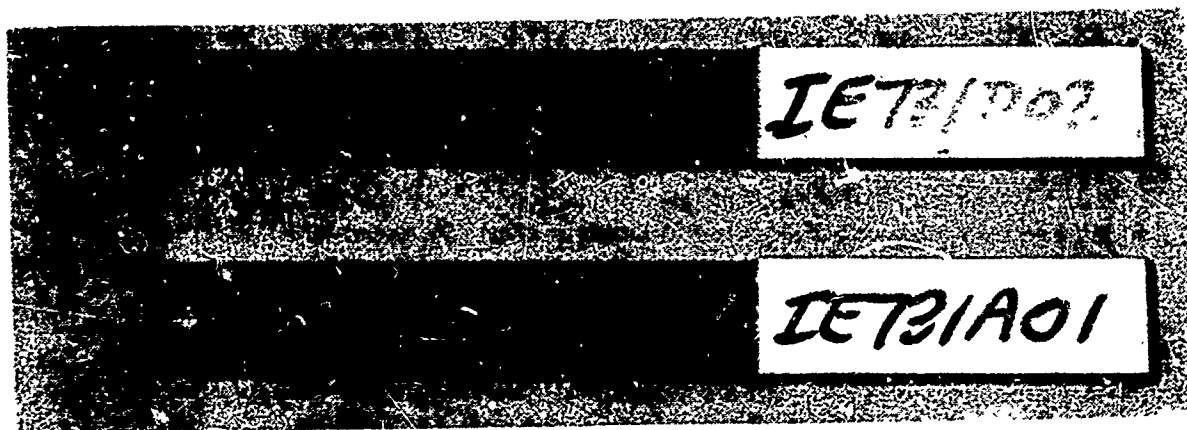


Figure 102 Pin Bearing Specimen ($0^\circ/+45^\circ$)
 $+45^\circ$ Boron Reinforced, $c/D = 2.0$
 -D02 Typical Static Failure
 -A01 Typical $R = -0.1$ Fatigue Failure

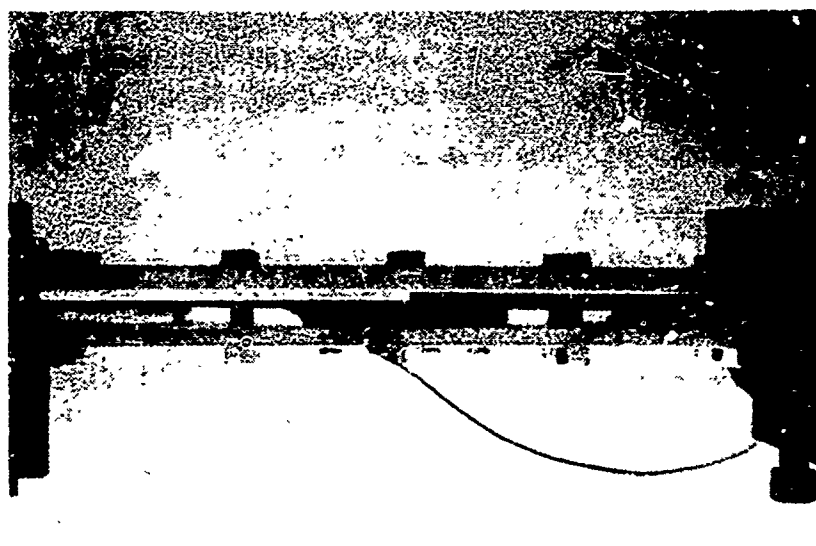


Figure 103 Mechanical Joints With Support Plates

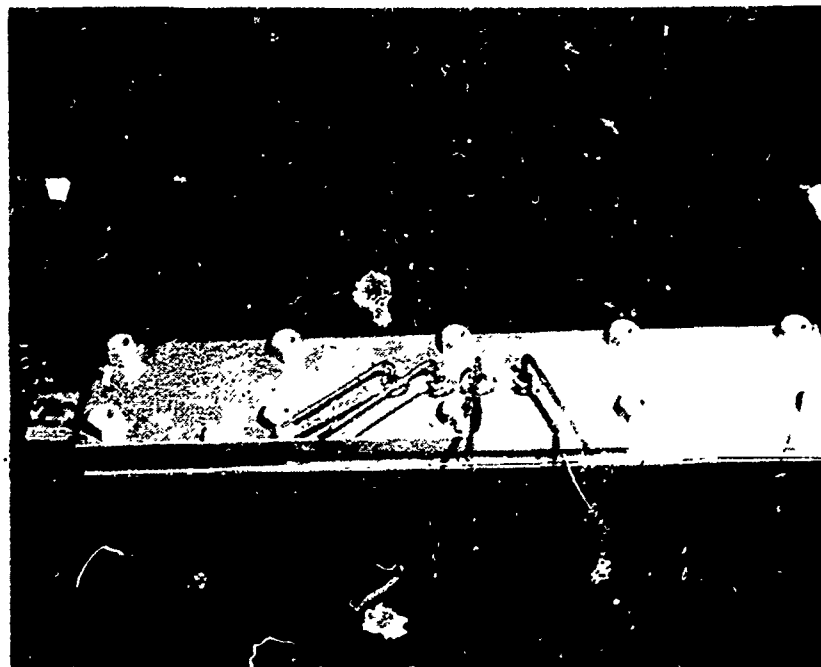


Figure 104 Test Set-Up For Monitoring Fastener Rotation

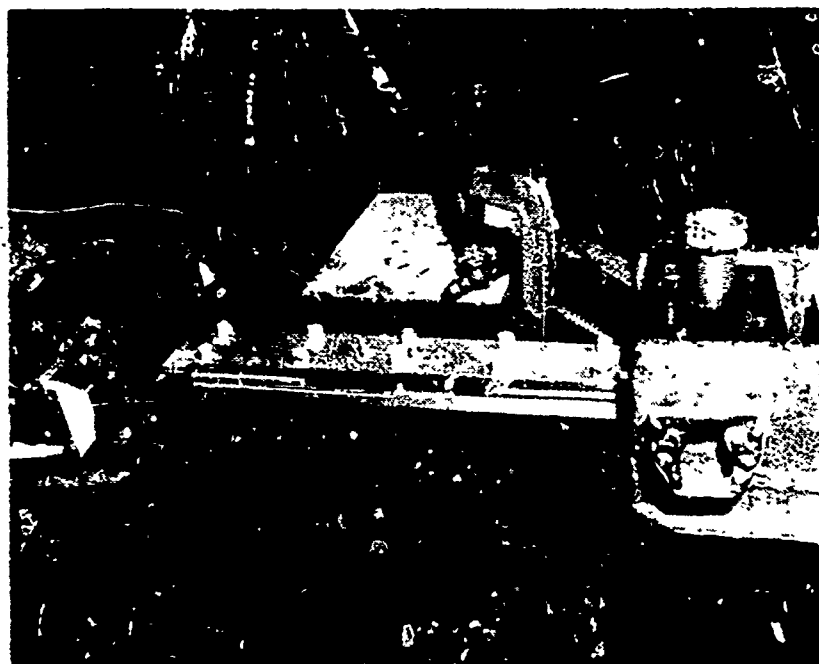


Figure 105 Set-Up For Maintaining Specimen Temperature

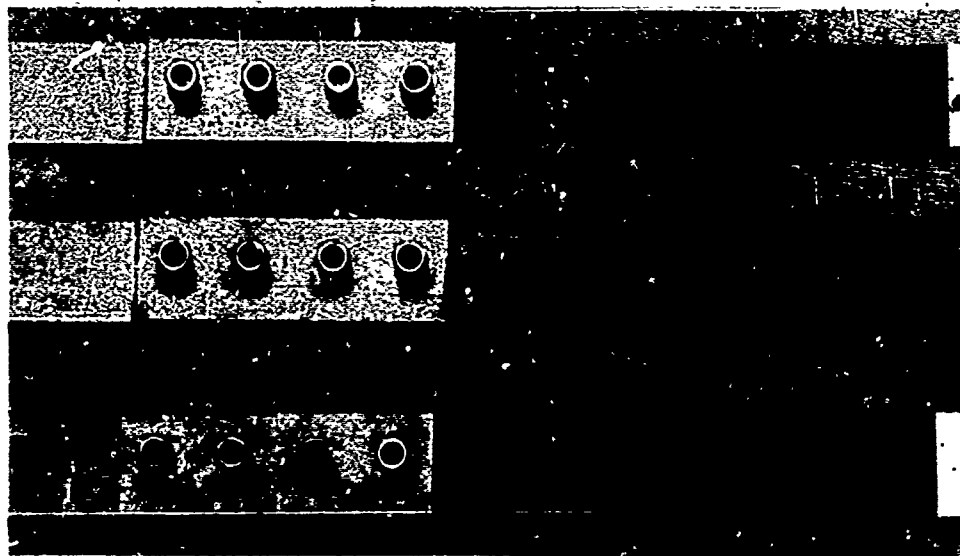


Figure 106 Configuration E, Baseline
(0°/+45°) Boron/Titanium
-D05 Typical Static Tensile Failure
-A02 Typical R = +0.1 Fatigue Failure
-D02 Typical Static Compression Failure

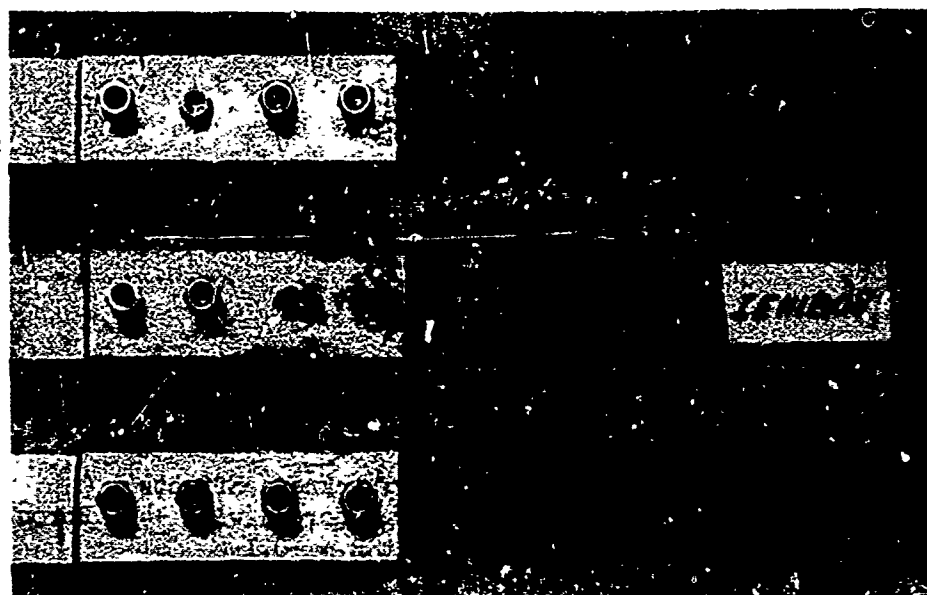


Figure 107 Configuration E, Baseline, $R = -1.0$
 $(0^\circ/+45^\circ)$ Boron/Titanium
 - Shown are three different types of failure.

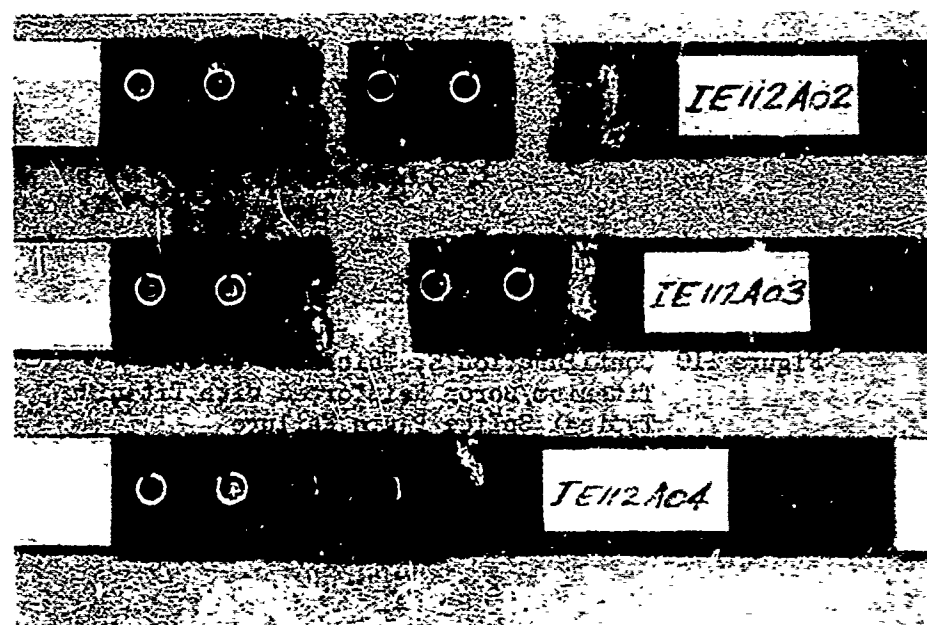


Figure 108 Configuration E, Baseline, $R = +0.1$
 Boron/Boron $(0^\circ/+45^\circ)$ with titanium inserts)
 - Shown are three different types of failure.

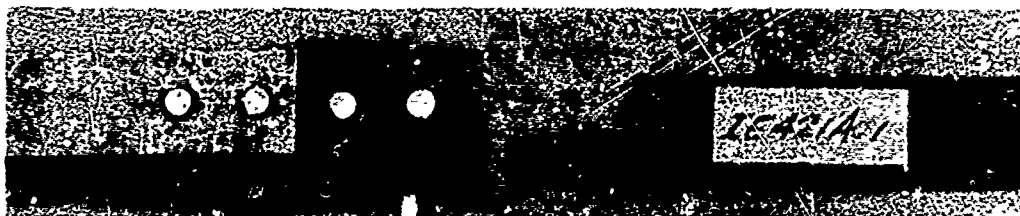


Figure 109 Configuration E, Thickness Effects
Titanium/Boron, Reinforced with $+45^\circ$ Boron
Typical Failure at $R = +0.1$

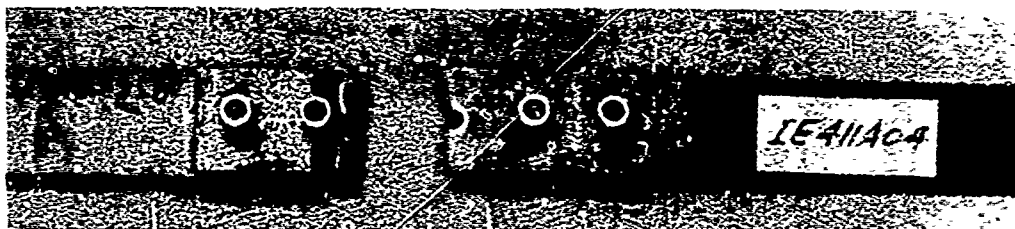


Figure 110 Configuration E, Thickness Effects
Titanium/Boron Reinforced with Titanium
Typical Splice Plate Failure

Reproduced from
best available copy.

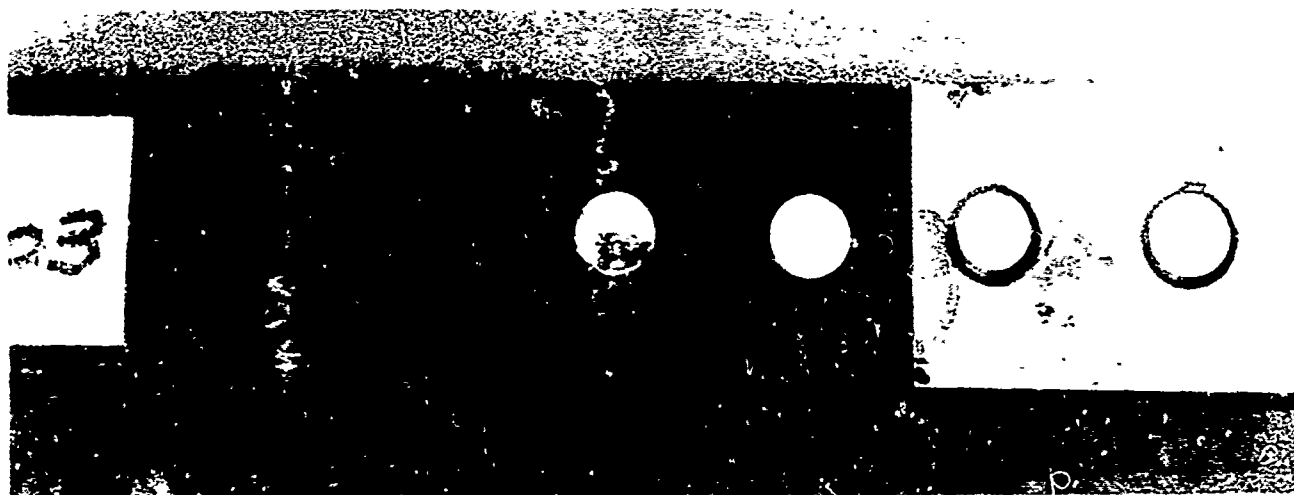


Figure 111 Configuration E, Short Edge Distance
Boron/Titanium, Titanium Shims in Boron

Fatigue damage can be seen at net section of boron
and also at edge of shim build-up section. Fatigue
test was discontinued after specimen (IE311A03) had
endured 13×10^6 cycles at $R = +0.1$.

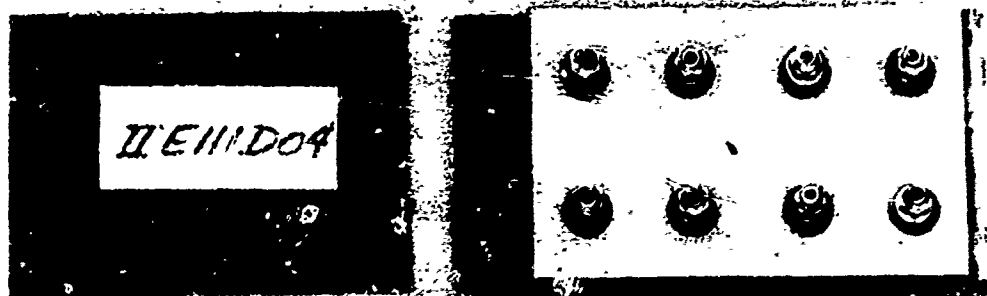


Figure 112 Configuration E, Two Inches Wide, Baseline
Typical Static Tensile Failure

Reproduced from
best available copy.

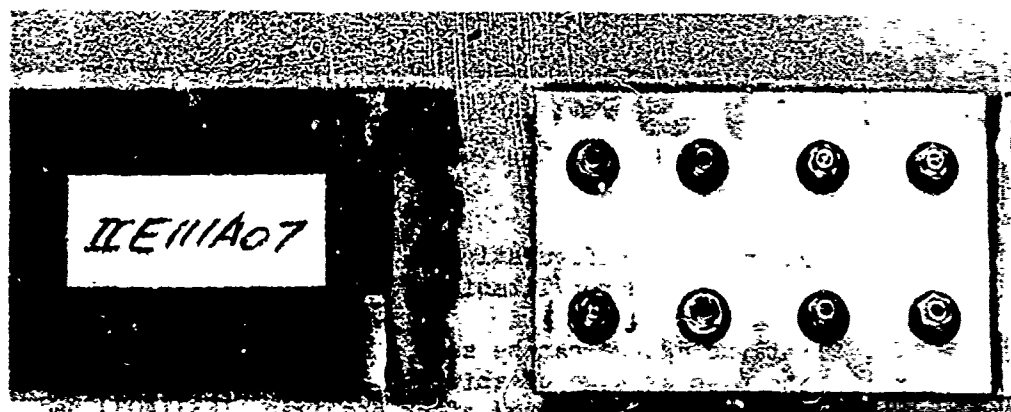


Figure 113 Configuration E, Two Inches Wide, Baseline
Typical $R = +0.1$ Fatigue Failure

boron has fatigue strength equal to or greater than titanium having up to 50 percent more net-section area.

Repeated attempts to obtain fatigue failures in the joints of the baseline specimens tested at a stress ratio of $R = +10.0$ were unsuccessful. Testing at this stress ratio was therefore discontinued, and all remaining test specimens were used for contingency or supplementary tests, as required, for providing additional test data to better define a test variable. For the specimens tested at a stress ratio of $R = -1.0$ the majority of failures occurred in the fasteners. Initially these failures were attributed to excessive bending action at the joint during reversed cycling. It was believed that the 0.003 inch clearance between the joint and the support plates was allowing excessive bending of the splice plate which results in repeated tension loading of the fastener through the steel collar. Subsequent testing with no clearance around the joint however, still resulted in some fastener fatigue failures.

4.11 MECHANICAL JOINT TESTS - CONFIGURATION F - TEE JOINT

4.11.1 Specimen Configuration

Specimen details are given in Dwg. No. 7226-1302IF, Appendix C, and specimen identification information is given on Table X.

4.11.2 Test Procedure and Results

Tests were conducted in accordance with Table X, and test data are reported in Appendix B, table IVB5.

A different test procedure was used for the Configuration F static tests than was previously used for the Configuration C (bonded tee joint) static tests. Since the mechanically fastened tee was capable of withstanding a considerably higher load than the bonded tee, emphasis was placed on axial load carrying capability. The support fixture that was used for the bonded tee specimens was modified to accommodate the longer leg of the mechanically fastened tee. Two specimens were tested using the same transverse loads that were used previously with two of the bonded tees and then the specimens were loaded axially to failure. Both failures occurred in the boron laminate at the edge of the titanium built-up section as shown in Figure 114.

The fatigue tests were conducted in the Lockheed designed fatigue machines using a similar testing procedure to that used for the bonded tee joint specimens. The baseline data specimens were tested at a stress ratio of $R = +0.1$ and at a maximum axial stress of 40,000 psi at the net section of the shimmed boron. A side load of 100 pounds was used on five specimens and a sideload of 250 pounds was used on the other five. The increased thickness specimens were tested in a similar manner but the maximum axial stress level was 35,000 psi and the side load was 500 pounds. Fatigue failures occurred at either the net section or at the edge of the shimmed boron section. The test results confirmed that the fatigue strength of the joint decreased with increased side load as expected.

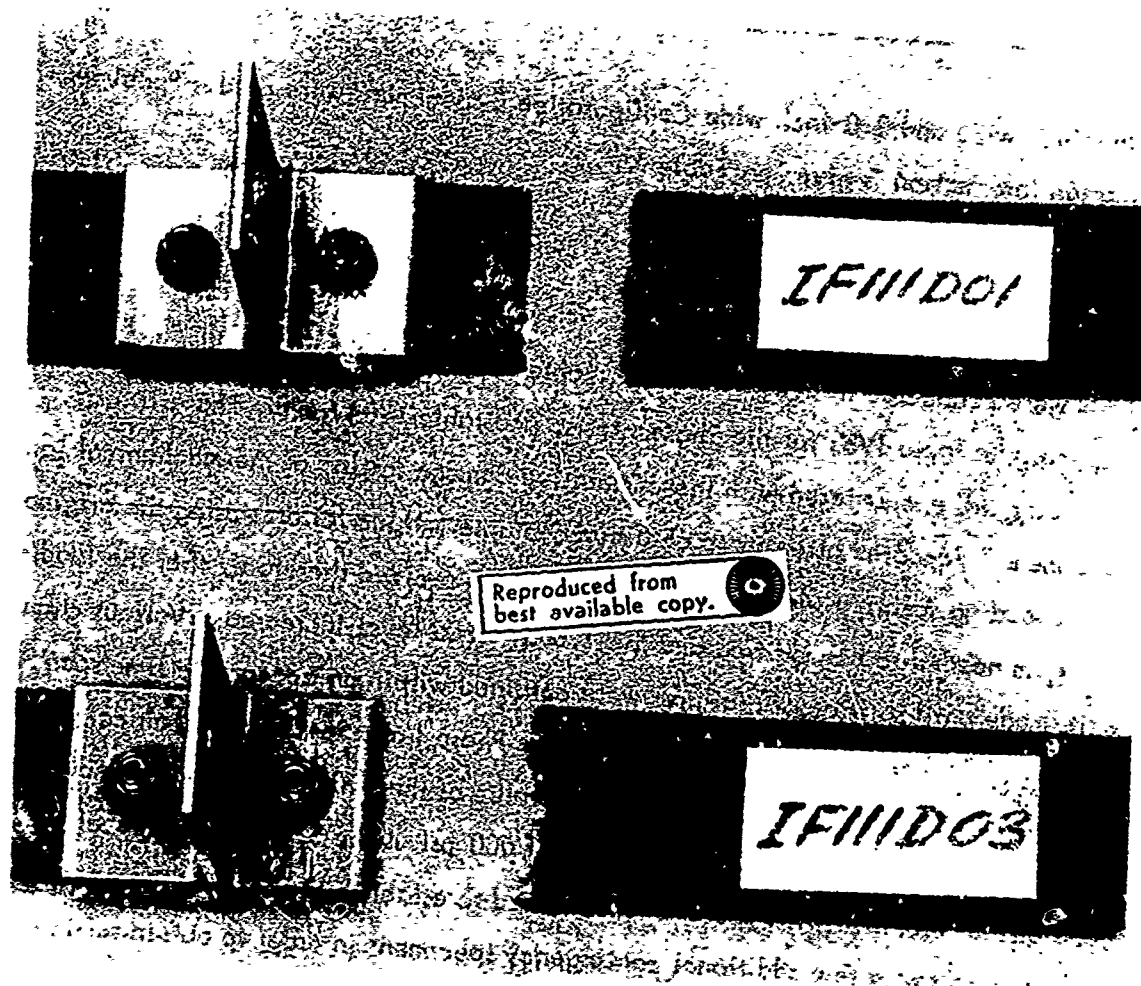


Figure 114 Configuration F Baseline Static Tests
 -D01 Side Load Held Constant, Axial Load
 Increased to Failure
 -D03 Axial Load Held Constant, Side Load
 Increased to Failure

4.12 MECHANICAL JOINT TESTS - CUMULATIVE DAMAGE

4.12.1 Specimen Configuration

One-inch wide and 2.0-inch wide Configuration E specimens were used. Specimen identification information is given on Table X.

4.12.2 Test Procedure and Results

Tests were conducted in accordance with Table X, and the test data are reported in Appendix B; table IVB1 for the Phase I tests, and table IVB4 for the Phase II tests. Some difficulty was encountered with the cumulative damage testing of the mechanical joint specimens. Repeated attempts to obtain acceptable fatigue failures using the original block loading spectrum were unsuccessful. It was decided therefore, that the loading spectrum needed to be modified and the 1.0 "g" load level increased. Various changes were made until satisfactory failures were obtained within an acceptable time span. The spectrum that was finally adopted for both the Phase I and Phase II mechanical joint specimens is presented in Table XI. The value of the 1.0 "g" load was selected to give a joint net section stress of approximately 39,000 psi at the 8.0 "g" load level. Since most of the 1.0-inch wide specimens were used to establish the loading spectrum, it was necessary to test a few additional contingency specimens in order to obtain sufficient data points for spectrum evaluation. The Phase I and Phase II realistic loading spectrum tests were conducted without any difficulties. In both cases the selection of the 1.0 "g" load level was based on the results of the block spectrum testing. All tests were conducted in the computer controlled MTS testing machine and the specimens were supported in the same manner as the Configuration E baseline specimens. All failures occurred at either the joint net section or at the edge of the titanium shim reinforcement.

4.13 SUMMARY

All data generated during this test phase has been plotted in S-N form and is included in Volume III, Section 2, Fatigue Analysis. In that section all results are analyzed, compared, and discussed in detail.

TABLE XI

TRUNCATED BLOCK SPECTRUM LOADINGS

Load in "g's"		Cycles of Load in Block Number:									
Min.	Max.	1	2	3	4	5	6	7	8	9	10
-3.6	+1	1	0	REPEAT BLOCK 1		REPEAT BLOCK 2		REPEAT BLOCK 1		REPEAT BLOCK 2	
-3.2	+1	1	1							REPEAT BLOCK 1	
-2.8	+1	4	4								
-2.4	+1	8	8								
-2.0	+1	11	11								
+1	+4	3600	3600								
+1	+5	1800	1800								
+1	+6	810	810								
+1	+7	237	237								
+1	+8	53	53								

APPENDIX A

FABRICATION AND INSPECTION LOGS

Fabrication and inspection details for all panels and specimens are summaries and recorded on the forms included herein. This Appendix is separated into sections by table numbers where each of the tables represent a particular group of specimens as defined by program phase, specimen configuration, drawing number, and specimen number.

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

BORON PANEL IDENTIFICATION

[illegible]

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 3

BORON PANEL IDENTIFICATION

Panel No.	8 PLY	15 PLY	7A1217	7B1217	3A1217	3B1217	15A1217	8 PLY	15 PLY	16 PLY	1B1218	15 PLY	14D105	7B0105	15 PLY	15 PLY	8 PLY
Boron Batch No.	408	408	408	408	408	408	408	408	408	408	408	408	408	408	408	42	42
Roll No.	39	39	39	39	39	39	39	39	39	39	39	39	40	40	40	1	1
Prev. Out Time Hr.	0	0	31	31	31	31	31	31	31	31	36.5	0	26	26	26	0	0
Start Time	1208/0930	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850	1216-0850
Complete Time	1209/1650	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550	1216-1550
Total Out Time Hr.	31	31	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Clean Room Temp.	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66	66
Clean Room R.H. %	52	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47
Ply Orientation	0°/45°	90°/0°	90°/0°	90°/0°	90°/0°	90°/0°	90°/0°	0°/90°	0°/90°	0°/90°	0°/45°	0°	0°/45°	90°/0°	0°	0°/45°	0°/45°
Number of Plies	9	15	8	8	8	8	8	8	15	16	16	15	8	8	15	15	8
Bleeder System	1-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116	2-116
Inspect Bag - "Hg"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"	28"
Autoclave LDR	A412782	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784	A412784
Date/Time	1210/1300	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200	1217-1200
Pressure - psig	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Temperature - °F	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350
Time at Temp. - Min.	120	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
Heat-Up Rate	6.4	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Laminate Thickness	.076	.076	.076	.076	.076	.076	.076	.076	.076	.076	.076	.076	.076	.076	.076	.076	.076
Mils Per Ply	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07	5.07
QC Lab No.	63652																

NOTES

(1) These panels were fabricated with peel ply and thickness is measured during specimen inspection

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

MATERIAL VERIFICATION AND CHECK OUT TEST SPECIMEN
FABRICATION AND INSPECTION LOG

Specimen No.	VL001	VL002	VL003	VL004	VL005	VL006	VL007	VL008	VL009
Panel									
Tab Bond									
Adhesive									
Pressure									
Temperature									
Date									
Time at Temp									
Tab Matl.									
Spec. Dimensions									
Long. Length-in.	2.5	2.15	2.12	2.09	2.02	2.10	2.11	2.11	2.10
Long. Width-in.	1.012	1.000	1.011	1.006	0.990	0.995	1.009	1.012	1.006
Long. Thickness-in.	0.0429	0.0431	0.0431	0.0431	0.0431	0.0431	0.0431	0.0431	0.0431
Comments									
Cell Ident-Off									
Technical Inspection									
A Sign-Off									

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

.. MATERIAL VERIFICATION AND CHECK OUT TEST SPECIMEN
.. VARIATION AND INSPECTION LOG

Specimen No.	V2A01	V2A02	V2A03	V2A04	V2A05	V2A06	V2C01	V2C02	V2C03
Panel	V2								
Tab Bond									
Adhesive	TM 12-2								
Pressure	10 lb/in ²								
Temperature	250°F								
Time at Temp	4-29								
Time at Temp	170 min								
Spec. Dimensions									
Length-in. (Nom.)	9.10	9.08	9.07	9.10	9.09	9.08	9.07	9.07	9.08
Width-in. (Nom.)	0.9890	1.0005	1.0014	1.0014	0.9991	1.0017	1.0014	1.0014	1.0022
Thickness-in. (Nom.)	0.0427	0.0429	0.0428	0.0428	0.0427	0.0427	0.0428	0.0428	0.0428
Comments	NONE								
42-11 Sign-Off	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY
Technical Inspection & Sign-Off	✓					✓			
All specimens were checked visually. Specimens with a check (✓) were inspected ultrasonically by immersion method.									
RPS									

188

MATERIAL VERIFICATION AND CHECK OUT TEST SPECIMEN
FABRICATION AND INSPECTION LOG (ADHESIVE)

Specimen No.	V3A01	V3A02	V3A03	V3A04	V3A05	V3A06	V3A07	V3A08	V3A09	V3A10	V3A11	V3A12	V3A13	V3A14	V3A15	V3C01	V3C02	V3C03	V3C04	V3C05
Panel Ident.	SEP. NO. 1																			
Tab Material	PRP																			
Tab Adhesive	PR 123-8																			
Spec. Length-in. Nom.	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Width-in. Nom.	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
Thick-in. Nom.	.061	.061	.059	.060	.0605	.061	.061	.061	.0615	.061	.0605	.0605	.060	.060	.061	.061	.061	.0605	.061	.0615
Splice Mat.	0-1-1 TITANIUM																			
Length-in. Nom.	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500	1.500
Width-in. Nom.	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
Thick-in. Nom.	.061	.060	.0615	.061	.060	.0605	.060	.0595	.060	.060	.059	.059	.060	.061	.060	.059	.059	.061	.061	.061
Adhesive Type	EA9601																			
Batch/Roll	347/46																			
Lay-Up Date	6/2																			
Cure Time	1330																			
Cure Date	6/5																			
Cure Time	1300																			
Inspection	10 date																			
Heat-Up Rate	7°/min																			
Cure Temp.	250°F																			
Time at Temp.	60 min																			
Joint Run No.	103094																			
Joint Thickness	.1265	.126	.125	.1245	.1245	.126	.1255	.126	.127	.126	.124	.1245	.124	.126	.1255	.1255	.1255	.1265	.126	.127
Spec. + Splice	.122	.121	.1205	.1210	.1205	.1215	.121	.1205	.1215	.121	.1195	.1195	.120	.121	.121	.120	.120	.1215	.122	.1225
Bondline Thick. Inches	.0045	.005	.0045	.0055	.004	.0045	.0045	.0055	.0055	.005	.0045	.005	.005	.0055	.0045	.0055	.0055	.005	.004	.0045
Inspect	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB	RJB
Comments																				
Bondline Taper																				
Specimen Box	.070	.060		.070	.020	.040	.04	.030		.011	.010		.010		.020	.010	.050		.060	
Classification	.040								.030										.010	
Mitres/notes	C-cured at 100° activities were obtained for all specimens and will be kept on file for comparison with the failed joints.																			
Note 1: Panel material is 0-1-1 titanium sheet.																				

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE A2 CONT.
PAGE 5

MATERIAL VERIFICATION AND CHECK OUT TEST SPECIMEN
FABRICATION AND INSPECTION LOG (ADDRESS)

Specimen No.	V1A21	V1A22	V1A23	V1A24	V1A25	V1A26	V1A27	V1A28	V1A29	V1A30	V1A31	V1A32	V1A33	V1A34	V1A35	V1A36	V1A37	V1A38
Panel Ident.			See Note 1															
Tab Material			FRP															
Tab Adhesion			PM 123															
Spec. Length-in. Nom.	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"	18"
Width-in. Nom.	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"
Thickness-in. Nom.	0.0617	0.0618	0.0614	0.0590	0.0602	0.0610	0.0615	0.0605	0.0610	0.0605	0.0611	0.0613	0.0605	0.0611	0.0613	0.0605	0.0611	0.0613
Splice No.	6-1-1	6-1-1																
Length-in. Nom.	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"	1.50"
Width-in. Nom.	0.994"	0.992"	0.994"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"	0.992"	0.991"
Thickness-in. Nom.	0.0605	0.0600	0.0604	0.0602	0.0603	0.0606	0.0595	0.0607	0.0605	0.0595	0.0600	0.0602	0.0605	0.0600	0.0602	0.0605	0.0600	0.0602
Adhesion Type	FR3601																	
Batch/Pl	247/46																	
Flow Rate	6/2																	
Flow	1339																	
Cure Rate	6/5																	
Time	1300																	
Area	30 sq in.																	
Heat-in Rate	17/min																	
Pure Temp.	250°F																	
Time at Temp.	60 min.																	
IDR Run No.	303054																	
Soil Temp.	0.1255	0.1255	0.1265	0.1245	0.1252	0.1260	0.1265	0.1272	0.1262	0.1252	0.1257	0.1260	0.1264	0.1257	0.1260	0.1264	0.1257	0.1260
Spec. Splice	0.1217	0.1212	0.1218	0.1192	0.1205	0.1216	0.1210	0.1216	0.1215	0.1210	0.1211	0.1215	0.1210	0.1211	0.1215	0.1210	0.1211	0.1215
Bondline Thickness	0.016	0.015	0.017	0.015	0.017	0.014	0.015	0.017	0.017	0.014	0.016	0.015	0.014	0.016	0.015	0.014	0.016	0.015
Inspect	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY	ECY
Comments																		
Bondline Temp	200 miles																	
Specimen Box																		
Visalignment																		

NOTES: 1. Panel material is 6-1-1 titanium sheet.

2. The specimen on this page are for use in establishing joint support procedures prior to testing the composite joint.

PHASE I - CONFIGURATION A (4)

PROPOSED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG

Specimen No.	JAL1109	JAL1109-2	JAL1109-1A	JAL1109-6	JAL1109-8	INTERIOR	(5)
Panel Ident.	JAL11E						→
Tab Ident.	Fiberglass						→
Adherent Thickness							
Left	.042 (1)						→
Right	.042 (1)						→
Splice Material	6Al-4V-Titanium Annealed						→
Splices Unlocks							
Left	.039 (1)					2/.039	→
Right	.039 (1)					2/.039	→
Adhesive Type	EA 9601-.05						→
Adh. Patch/Holt	162-5/A						→
Lay-Up Date	7-1-70					7-7-70	→
Lay-Up Time	1530					1000	→
Cure Date	7-2-70					7-7-70	→
Cure Time	.0800					1800	→
Cure Pressure	30 Psi						→
Heat-Up Date							→
Cure Temp./Time	200°F/60						→
Joint Thickness							
Left	.0952	.0950	.0935	.0950	.0950	.128	→
Right	(2)						→
Resilience Thick. Mils							
Left	.0455	.004	.005	.004	.004	.004 2/.004	→
Right	(2)						→
Inspect	RJB						→
Quality Assur.	Ultrasonic C-Scans and X-Ray Performed on all Specimens R.F.S.						

Notes (1) Nominal thickness are used
(2) Right side is the same as left since nominal thicknesses recorded
(3) Double overlap butt joint for photo-stress evaluation
Joints JAL1109 thru JAL1106 were to evaluate test set up procedure
(4) All specimens on this sheet are trial specimens to establish testing procedures and limitations. These are not part of the main phase I required specimens but will be used to complement the required tests.

[illegible]

REPORT NO. _____
MODEL Table A-3
PAGE _____

PHASE I - CONFIGURATION A

NOTES:

(2)	Specimen number D-11D04	was static tested at time of machining and was not measured for joint thickness.	Bond line is assumed
-----	-------------------------	--	----------------------

to be approximately 5 mils thick.

REPORT NO. _____
 MODEL - Table A-3
 PAGE 4

PHASE I - CONFIGURATION A

	(1) Specimen IALIA was acidic tested at the time of machining and was not measured for joint thickness. Bond line in assumed to be approximately 5 mils thick.	
--	--	--

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL: TABLE A3
PAGE: 5

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

PHASE I - CONFIGURATION A

	1A01	1A02	1A03	1A04	1A05	1A06	1A07	1A08	1A09	1A10	1A11	1A12	1A13	1A14	1A15	1A16	1A17	1A18	1A19	1A20
Specimen No. 1A-	(1)	711004	(1)	111B02	111C02	111D02	711F02	511A03	111C03	511C02	111B03	111A01	111C04	(1)	511D01	1A-B04	111A02	511A04	811A03	511A05
Panel Ident.	1A11P																			
Tab Ident.	7075-76	Alumina																		
Adhesive Thickness																				
Inches	.0435	.0439	.0438	.0440	.0440	.0440	.0440	.0440	.0480	.0481	.0476	.0445	.0441	.0438	.0440	.0440	.0445	.0447	.0441	.0429
Splice Material:	6 Al - 4 V	Titanium annealed																		
Splice Thickness																				
Inches - Nom.	.041																			
Adhesive Type	EA 9601-99																			
Adh. Batch/No.	661-46/82																			
Ins-Up Date	2-20																			
Cure Date	9-15																			
Cure Time	1130																			
Cure Pressure	30																			
Joint Type	4.7																			
Cure Temp./Time	260°/95																			
Bondline Thick. Mils																				
Left	5.3	6.2	5.9	6.7	5.9	6.5	5.5	6.6	6.9	6.5	6.4	5.8	5.6	7.0	5.6	6.0	6.7	6.3	6.4	6.3
Right	5.4	5.4	5.7	6.1	6.1	6.2	6.2	6.3	6.7	7.2	6.5	6.7	5.2	6.1	6.5	6.4	6.2	6.2	6.6	6.7
Inspect	Fabrication inspection performed on all specimens E. C. Young																			
Quality Assur.	All specimens checked for bondline thickness. Ultrasonic C-scan and X-ray performed on all specimens R. E. Shupe																			
Notes:																				
(1) These specimens are to be held for conformity and when selected for testing they will be assigned a specimen number.																				

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO.
TABLE A-3
PAGE 7

PHASE I - CONFIGURATION A

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG																					
PROBATION PHASE AND SPECIMEN IDENTIFICATION NUMBER																					
PHASE I - CONFIGURATION A																					
Spec. No.	Spec. ID	1A21	1A22	1A23	1A24	1A25	1A26	1A27	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40
1A21	1A21	1A21	1A22	1A23	1A24	1A25	1A26	1A27	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40
1A22	1A22	1A22	1A23	1A24	1A25	1A26	1A27	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40	
1A23	1A23	1A23	1A24	1A25	1A26	1A27	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40		
1A24	1A24	1A24	1A25	1A26	1A27	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40			
1A25	1A25	1A25	1A26	1A27	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40				
1A26	1A26	1A26	1A27	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40					
1A27	1A27	1A27	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40						
1A28	1A28	1A28	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40							
1A29	1A29	1A29	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40								
1A30	1A30	1A30	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40									
1A31	1A31	1A31	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40										
1A32	1A32	1A32	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40											
1A33	1A33	1A33	1A34	1A35	1A36	1A37	1A38	1A39	1A40												
1A34	1A34	1A34	1A35	1A36	1A37	1A38	1A39	1A40													
1A35	1A35	1A35	1A36	1A37	1A38	1A39	1A40														
1A36	1A36	1A36	1A37	1A38	1A39	1A40															
1A37	1A37	1A37	1A38	1A39	1A40																
1A38	1A38	1A38	1A39	1A40																	
1A39	1A39	1A39	1A40																		
1A40	1A40	1A40																			
1A41	1A41	1A41																			
1A42	1A42	1A42																			
1A43	1A43	1A43																			
1A44	1A44	1A44																			
1A45	1A45	1A45																			
1A46	1A46	1A46																			
1A47	1A47	1A47																			
1A48	1A48	1A48																			
1A49	1A49	1A49																			
1A50	1A50	1A50																			
1A51	1A51	1A51																			
1A52	1A52	1A52																			
1A53	1A53	1A53																			
1A54	1A54	1A54																			
1A55	1A55	1A55																			
1A56	1A56	1A56																			
1A57	1A57	1A57																			
1A58	1A58	1A58																			
1A59	1A59	1A59																			
1A60	1A60	1A60																			
1A61	1A61	1A61																			
1A62	1A62	1A62																			
1A63	1A63	1A63																			
1A64	1A64	1A64																			
1A65	1A65	1A65																			
1A66	1A66	1A66																			
1A67	1A67	1A67																			
1A68	1A68	1A68																			
1A69	1A69	1A69																			
1A70	1A70	1A70																			
1A71	1A71	1A71																			
1A72	1A72	1A72																			
1A73	1A73	1A73																			
1A74	1A74	1A74																			
1A75	1A75	1A75																			
1A76	1A76	1A76																			
1A77	1A77	1A77																			
1A78	1A78	1A78																			
1A79	1A79	1A79																			
1A80	1A80	1A80																			
1A81	1A81	1A81																			
1A82	1A82	1A82																			
1A83	1A83	1A83																			
1A84	1A84	1A84																			
1A85	1A85	1A85																			
1A86	1A86	1A86																			
1A87	1A87	1A87																			
1A88	1A88	1A88																			
1A89	1A89	1A89																			
1A90	1A90	1A90																			
1A91	1A91	1A91																			
1A92	1A92	1A92																			
1A93	1A93	1A93																			
1A94	1A94	1A94																			
1A95	1A95	1A95																			
1A96	1A96	1A96																			
1A97	1A97	1A97																			
1A98	1A98	1A98																			
1A99	1A99	1A99																			
1A100	1A100	1A100																			

(1) These specimens are to be held for contingency and when selected for testing they will be assigned a specimen.

REPORT NO. _____
MODEL _____
PAGE _____

[illegible][illegible]

PHASE I - CONFIGURATION A

REBONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG																			
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER																			
PHASE 1 - CONFIGURATION A																			
	LA61	LA62	LA63	LA64	LA65	LA66	LC01	LC02	LC03	LC04	LC05	LC06	LC07	LC08	LC09	LC10	LC11	LC12	LC13
DWG #7226-13021A-																			
Specimen No. 1A-	(1)	711604	111010	111310	111A09	511C07	112A01	112A02	112D01	112A03	112A04	112A05	112D02	112A06	112A07	112A08	112D03	112A09	112A10
Panel Ident.	1A11P					►	1A110949												►
Tab Ident.	7075-T6 Aluminum					►	7075-T6 Aluminum												►
Adhered Thickness																			
Anchors	Q44	Q44	Q44	Q43	Q43	Q44													►
Splice Material	6A1-IV Titanium Annealed					►	7075-T6 Aluminum												►
Splice Thickness						►	.060												►
Adhesive Type	EA9601-06					►	EA9601-06												►
Adh. Batch/Roll	364-46/B2					►	364-46/B2												►
Lay-Up Date	9/16						10/13/70												►
Lay-Up Time	1:00						1:00												►
Cure Date	9/17						10/14												►
Cure Time	1:00						1:05												►
Cure Pressure	30	►	LDR #38597			►	30	►	LDR #12763										►
Heat-Up Rate 0/Min.	5.5						5												►
Cure Temp./F	260/65						275/85												►
Bondline Thick. Mile																			
Left	5.0	4.7	5.0	4.7	5.1	5.3													
Right	5.7	5.4	5.4	5.0	5.1	5.1													
Inspect	Fabrication inspection per drawing performed on all specimens E. C. Young																		
Quality Assur.	All specimens checked for bondline thickness. Ultrasonic C-section and X-rays performed on all specimens - R. E. Shupe																		
NOTES:																			
(1) These specimens are to be held for contingency and when selected for testing they will be assigned a specimen number.																			

Notes:

	(1) These specimens are to be held for contingency and when selected for testing they will be assigned a specimen number.
--	---

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I - CONFIGURATION A

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

	1A111	1A112	1A113	1A114	1A115	1A116	1A117	1A118	1A119	1A120	1A121	1A122	1A123	1A124	1A125	1A126	1A127	1A128	1A129
Specimen No. 1A-	111B21	111A08	111A10	111A09	111A05	111A21	111C08 (1)	111F05	111A10	111B25	111A09 (1)	111B25	111B25	111B22	111C09	111A22	111C21	111A10	111A10 (1)
Panel Ident.	1A1101B																		
Tab Ident.	7015-76	ALUMINUM																	
Adhered Thickness	.046	.046	.046	.046	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047
Splice Material	6AL-4V	TITANIUM ANNEAL																	
Splice Thickness																			
Inches-Hoc.	.010																		
Adhesive Type	Epoxy-10																		
Adh. Mass/Inch	304-152																		
Lay-Up Date	10/29/70																		
Lay-Up Time	1100																		
Cure Date	10/29/70																		
Cure Time	1430																		
Cure Pressure	3																		
Heat-Up Rate °/Min.	5°																		
Cure Temp./Time	265°/75 Min.																		
Bondline Thick. Min.																			
1st	5.5	4.9	4.9	5.3	5.6	5.9	5.8	5.9	7.2	7.1	6.0	7.0	7.7	6.4	6.8	7.0	6.6	6.5	6.8
2nd	5.5	5.5	5.9	5.6	5.5	7.3	6.6	6.6	9.6(2)	7.0	8.9	6.2	5.9	6.1	7.5	7.4	6.5	6.9	6.5
Inspection	Fabrication inspection per drawing performed on all specimens - R. J. Bradley.																		
Quality Assur.	All specimens checked for bondline thickness, ultrasonic c-scan and x-rays per R. E. Shure.																		
NOTES:																			
(1) These specimens are to be held for contingency and when selected they will be assigned a specimen number.																			
(2) This has a very thick bondline but will be tested and reported with other data.																			

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 11

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG - PHASE I - CONFIGURATION A

PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

DMG #/226-13024-	JA130	JA131	JA132	JA133	JA134	JA135	JA136	JA137	JA138	JA139	JA140	JA141	JA142	JA143	JA144	JA145	JA146	JA147	JA148	JA149
Specimen No. LA-	11C22	511C10	111A24	711F11	511D06 (1)	JA135 (1)	111B26	111B27	111B28	111B29 (1)	111B29	111B30 (1)	111B31	111B32	511A14	511A11	511C1	511D07	511A12	
Panel Ident.	LA111015																			
Tab Ident.	7075-T6	ALUMINUM																		
Adhesend Matchmarks																				
Inches	.047	.047	.047	.047	.047	.046	.047	.047	.047	.047	.047	.047	.047	.047	.0445					
Splice Material	5AL-4V	Titanium Annealed																		
Splice Thickness																				
Inches-Mm.	.040																			
Adhesive Type	EA9601-06																			
Adh. Bat./h/roll	361-153/1																			
Lay-Up Date	10/29/70																			
Lay-Up Time	1100																			
Cure Date	10/29/70																			
Cure Place	1430																			
Cure Pressure	30																			
Heat-Up Rate °/Min.	50°																			
Cure Temp./Time	265°/75 min.																			
Bondline Thick. Milu																				
Left	6.1	7.0	6.0	6.6	6.4	6.3	6.3	5.2	5.5	5.7	5.2	6.2	6.2	6.2	5.3	5.4	5.7	6.0	6.2	
Right	6.9	7.2	6.7	7.0	6.0	6.6	6.0	5.1	5.5	6.4	6.0	6.0	6.3	6.2	6.2	5.1	6.2	5.4	5.9	
Inspect	Fabrication inspection per drawing performed on all specimens - R. J. Bradley.																			
Quality Assmt.	All specimens checked for bondline thickness. Ultrasonic scan and x-rays performed on all specimens - R. S. Shupe																			
NOTES:																				
(1) These specimens are to be held for contingency and when selected for testing they will be assigned a specimen number.																				

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 12

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

PHASE I - CONFIGURATION A

UNO #224-13021A-	LA150	LA151	LA152	LA153	LA154	LA155	LA156	LA157	LA158	LA159	LA160	LA161	LA162	LA163	LA164	LA165
Specimen No. LA-	511A12	511A13	511A15	711G01	511A17	711G02	511D08	711G03	111B33	511A16	711G04	511A18	511D09	711F06	511A19	711G05
Panel Ident.	LA1210			LA1101B												
Tab Ident.	707-76 Alum.															
Adhesive Thickness																
Inches	.0145			.0420	.0420	.0420	.0420	.0420	.0430	.0425	.0420	.0420	.0425	.0425	.0415	.0415
Splice Material	6-6-Ti Annelled															
Splice Thickness																
Inches	.040															
Adhesive Type	EA 9601-0n															
Alt. Batch/Rel	164-160/0			381-7/1												
Lay-Up Date	12/16/70			1/13/71												
Lay-Up Time	11:45			0900												
Cure Date	12/16/70			1-19-72			1BR	4/12/91								
Cure Time	1345			1305												
Cure Pressure	5			30												
Heat-Up Rate °/Min.	50			5												
Cure Temp./Time	260°/90 Min.			265°/90												
Bondline Thick. in.																
Left	6.1	6.1	5.1	5.7	5.0	5.4	5.3	5.0	2.5	5.1	5.5	5.9	5.7	5.2	5.9	5.6
Right	6.2	5.8	5.8	5.1	5.5	5.4	4.8	5.8	5.2	5.4	5.5	5.8	5.7	5.3	5.3	5.5
Inspect.	Fab. insp. per 744, all specime - R. J. Bradley															
Quality Assurance	Bondline thickness, cross-section and X-ray inspection on all specimens - R. E. Shupe.															

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG																					
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER																					
PHASE 1 - CONFIGURATION A																					
LB01	LB02	LB03	LB04	LB05	LB06	LB07	LB08	LB09	LB10	LB11	LB12	LB13	LB14	LB15	LB16	LB17	LB18	LB19	LB20	LB20	
DWG #7226-13027A- Specimen No. 1A- Panel Ident. Tab Ident. Adherend Thickness Inches Splice Material Splice Thickness Inches-Nom. Adhesive Type Adh. Batch/Roll Lay-Up Date Lay-Up Time Cure Date Cure Time Cure Pressure Heat-Up Rate °/Min. Cure Temp./Time Bondline Thick. Mils Left Right Inspect Quality Assur.	113A01 11D01 111121 1075-T6 Aluminum Nominal .044 8-Ply Boron 0°/45° 1111924 .044 EA 9601-06 364-46/82 10/2/70 1000 10/2/70 1440 30 5.3 260°F/30 Min. Bondline Thick. Mils Left Right Inspect Quality Assur.	(1) (1) Aluminum Nominal .044 8-Ply Boron 0°/45° 1111924 Aluminum EA 9601-06 364-46/82 10/2/70 1000 10/2/70 1440 30 5.3 260°F/30 Min. Bondline Thick. Mils Left Right Inspect Quality Assur.	113A02 113A02 <																		

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE A3
PAGE 14

BONDED JOINT SPECIMEN - FABRICATION AND INSPECTION LOG														PHASE 1 - CONFIGURATION A													
PHOTOM MUSEL AND SPECIMEN IDENTIFICATION NUMBER																											
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04	1BX05	1BX06	1BX07	1BX08	1BX09	1BX10	1BX11	1BX12	1BX13															
1BX01	1BX02	1BX03	1BX04																								

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE A3
MODEL. 15
PAGE 15

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

	9A01	9A02	9A03	9A04	9A05	9A06	9A07	9A08	9A09	9A10	9A11	9A12	9A13	9A14	9A15	9A16	9A17	9A18	9A19	9A20
DWG #72-20-13021A-																				
Specimen No. IA-	311A01	311D01	311A02	311A10	311A03	311D02	311A04	311A05	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	311A11	311A12	311D04	311A13
Panel Ident.	21110911																211210			
Tab Ident.	7075-76	Aluminum																		
Adherent Thickness																				
Inches	.047																.0445			
Splice Material	6AL-4V	Titanium	Annealed																	
Splice Thickness																				
Inches-MCM.	.040																			
Adhesive Type	EA 9601-06								EA 9601-06									EA 9601-06		
Adh. Batch/Roll	364-46/82								364-46/82								364-160/0			
Lay-Up Date	10/6/70								10/13/70								12/16/70			
Lay-Up Time	1000								1000								1145			
Cure Date	10/7/70								10/14/70								12/16/70			LDR 412183
Cure Time	1345								1055								1345			
Cure Pressure	30								30								30			
Heat-Up Rate °/Min.	7								5								5			
Cure Temp./Time	260°/70 Min.								275°/85 Min.								260°/90 Min.			
Bondline Thick. Mils																				
Left	5.1	5.9	6.7	6.1	6.7	4.9	5.4	6.1	4.7/8.4	4.6/7.5	4.8/6.9	5.5	5.4	4.6	4.6	4.6	4.5	5.0	4.8	5.6
Right	6.3	6.4	6.7	6.4	6.9	5.0	6.4	6.5	5.2	4.9	5.0	4.5/5.9	4.0/5.7	4.3	4.7	5.4	4.4	4.9	5.8	5.0
Inspect	Fabrication inspection per drawing performed on all spec. - R. J. Bradley																			
Quality Assur.	All specimens checked for bondline thickness. Ultrasonic c-scan and X-ray - R. E. Shupe.																			
NOTES:																				
(1) Due to bondline taper all specimens cut from this panel are held in abeyance.																				

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
PAGE 16

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG																				
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER																				
PHASE I - CONFIGURATION A																				
Specimen No. 1A-	9A21	9A22	9A23	9A24	11A01	11A02	11A03	11A04	11A05	11A06	11A07	11A08	11A09	11A10	11A11	11A12	11A13	11A14	11A15	11A16
Panel Ident.	(1)	311D05	311A14	311A15	911A01	911C01	(1)	911D01	911A02	911C02	(1)	911A03	911C03	911D02	(1)	911A04	911C04	911A05	911C05	(1)
Tab Ident.	1A1210				1A11924															
Adherent Thickness	7075-T6 Aluminum				7075-T6 Aluminum															
Inches	0.445																			
Splice Material	6AL-4V Ti Annealed																			
Splice Thickness																				
Inches-Now.	.040																			
Adhesive Type	EA 9301-UV				EA 9301-UV															
Adh. Ratio/Ref	104-104/2				364-104/B-2															
Lay-Up Date	12/16/70				10/6/70															
Lay-Up Time	1145				100%															
Cure Date	12/16/70				10/11/70															
Cure Time	1345				1345															
Cure Pressure	30				30															
Heat-Up Rate °/Min.	5				7															
Cure Temp./Time	200/30 Min.				260/70 Min.															
Bondline Thick. Mils																				
Left	5.8	5.8	5.2	5.2	(2)	5.6	5.5	6.5	6.4	6.2	6.3	6.0	5.5	6.3	5.8	5.6	4.8	5.4	7.1	6.6
Right	6.0	6.5	6.4	5.7	(2)	6.0	5.9	6.2	5.8	5.9	6.0	6.6	5.2	5.4	5.0	5.8	5.1	5.7	7.0	7.0
Inspect	Fabrication inspection per drawing on all specimens - R. J. Bradley.																			
Quality Assur.	Nonline measurements, E-section and x-ray inspection - R. E. Shure.																			
NOTES:																				
(1)	These specimens held up contingently and when selected for testing they will be assigned a specimen number.																			
(2)	Bondline thickness was not measured on this specimen; however thickness should correspond to the thicknesses of the other bondlines in this group.																			

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. **TABLE 3A**
PAGE **17**

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG																		
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER																		
PHASE I - CONFIGURATION A																		
DWG #1226-13021A-	11A17	11A18	11A19	11A20	11A21	11A22	11A23	11A24	11A25	11A26	11A27	11A28	11A29	11A30	11A31	11A32	11A33	11A34
Specimen No. 1A-	911D03	911A06	911C06	(1)	911A07	911C07	911D04	(1)	911A08	911C08	(1)	911A09	911C09	911D05	911D06	911A10	911C10	(1)
Panel Ident.	1A11924																	
Tab Ident.	7075-T6 Aluminum																	
Adherend Thickness																		
Inches																		
Splice Material	6AL-4V	Titanium Annealed																
Splice Thickness																		
Inches-4mm.	.040																	
Adhesive Type	EA 9601-06																	
Adh. Batch/Roll	364-46/12																	
Lay-Up Date	10/6/70																	
Lay-Up Time	1000																	
Cure Date	10/7/70	→ LDR 412783																
Cure Time	13.5																	
Cure Pressure	30																	
Heat-Up Rate °/Min.	7																	
Cure Temp./Time	260/70 Min.																	
Bondline Thick. Mils																		
Left	7.0	6.5	5.2	5.2	6.1	5.7	6.2	6.3	6.7	5.9	5.9	6.0	5.3	5.6	6.1	6.4	5.6	5.8
Right	6.0	6.2	6.2	6.7	6.2	5.1	5.7	5.5	5.8	5.9	5.6	6.0	6.3	5.8	5.6	5.8	6.6	6.4
Inspect	Fabrication inspection per drawing on all specimens - R. J. Bradley.																	
Quality Assur.	Bondline measurements, Q-scan and X-ray inspection - R. E. Shupe.																	
NOTES:																		
(1) These specimens held as contingency and when selected for testing they will be assigned a specimen number.																		

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

BONDED JOINT SPECIFICATIONS - FABRICATION AND INSPECTION LOG		PHASE I - CONFIGURATION A															
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER																	
DWG 7226-13021A	JA166	JA167	JA168	JA169	JA170	JA171	JA172	JA173	JA174	JA175	JA176	JA177					
Specimen No. 1A	111B345	111B355	111B36	111D12	111B375	111B385	711U08	711U06	711G09	111D13	711G07	711G10					
Panel Ident.	11A021D																
Tab Ident.	Aluminum																
Adherend Thickness																	
Inches	0.044	Not.															
Splice Material	T3 -6-4																
Splice Thickness																	
Inches - Not.	0.040																
Adhesive Type	BA9601-06																
Adh. Batch/Ref.	3B3-5/U2																
Lay-up Date	2/22/71																
Lay-up Time	5:00																
Cure Date	2/23/71																
Cure Time	1023																
Cure Pressure	30																
Heat-up Rate 0/min.	5.75																
Cure Temp./Time	260°F/75 Min.																
Bondline Thick. Mils	4.6	4.8	4.5	4.4	4.0	4.3	4.3	4.5	4.1	4.5	5.2	4.3					
Left	4.1	5.1	4.0	4.5	4.0	4.5	4.3	4.7	4.4	5.0	5.2	4.3					
Inspect.	Feb. Instr. per dvg. all specimen - R. D. Bradley																
Quality Assur.	Bondline thickness, clean and X-ray inspection on all specimens - R. D. Shupe.																

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 1

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PHASE I - CONFIGURATION D

PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

	1A01	1A02	1A03	1A04	1A05	1A06	1A07	1A08	1A09	1A10	1A11	1A12	1A13	1A14	1A15
DWG #726-1102D-															
Specimen No. ID-	1A01	1A02	11D01 (1)	11D02	11A03	11A04	11A05	11A06	11A07	11A08	(1)	11D03	11A09	11A10	
Part Ident.	ID-1A1210														
Tab Ident.	7075-T6 Aluminum														
Adherent Thickness															
Left-Inches	.0835	.083	.084	.084	.084	.084	.084	.084	.084	.084	.084	.083	.0835	.0835	
Right-Inches	.0835	.083	.083	.084	.084	.084	.084	.084	.084	.0835	.084	.084	.084	.0835	
Splice Material	6AL-4V Titanium Annealed														
Splice Thickness															
Upper-Inches	.040														
Lower-Inches	.040														
Adhesive Type	EA 9601-06														
Adh. Patch/Hol.	164-160/0														
Lay-Up Date	12/17/70														
Lay-Up Time	1410														
Cure Date	12/18/70														
Cure Time	1130														
Cure Pressure	30														
Heat-Up Rate, °/Min.	6														
Cure Temp./Time	260/90 Min.														
Bondline Thick. Mils															
Upper Left	7.7	6.2	6.2	7.0	6.7	7.0	7.5	7.0	7.0	7.0	7.2	6.0	6.0	7.0	6.0
Upper Right	8.0	6.7	6.0	7.0	7.2	7.0	7.0	7.0	7.0	7.2	6.5	7.5	6.0	6.7	6.7
Lower Left	6.5	6.5	6.2	6.7	6.5	6.2	7.2	6.7	7.0	6.7	7.0	6.7	6.0	6.2	7.0
Lower Right	5.7	5.5	6.5	6.5	6.2	6.2	6.7	7.0	7.0	7.2	6.7	6.7	6.5	6.5	6.7
Inspect	Fabrication inspection performed on all specimens - R. J. Brulley.														
Quality Assur.	Bondline thickness, ultrasonic G-scan and X-ray inspection - R. E. Shupe.														
NOTES:															
(1) These specimens held as contingency and when selected for testing they will be assigned a specimen number.															

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE A5
PAGE 1

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

	1A01	1A02	1A03	1A04	1A05	1A06	1A07	1A08	1A09	1A10	1A11	1A12	1A13	1A14	1A15
DWG #1226-13021C-															
Specimen No. IC-															
Panel Ident.	IC-0105														
Spec. Thick Inches	.049	.049	.049	.049	.049	.049	.050	.050	.050	.049	.049	.049	.049	.049	.049
Toe Thickness															
Left - Inches	.119	.120	.119	.112	.120	.121	.120	.119	.121	.119	.119	.121	.120	.121	.120
Right - Inches	.128	.127	.129	.131	.129	.130	.129	.127	.129	.128	.129	.128	.127	.129	.127
Adhesive Type	EA9601-26														
Adh. Batch/roll	383-574														
Lay-Up Time	1330														
Lay-Up Date	1/21/71														
Cure Time	.0820														
Cure Date	1/22/71														
Cure Pressure	30														
Heat-Up Rate °/Min.	6.4														
Cure Temp./Time	260°F/8t Min.														
Bondline Thick. Mils															
Left	6.2	6.0	6.0	6.0	6.2	6.0	6.2	6.0	6.2	6.2	6.0	6.0	6.0	6.2	6.2
Right	5.7	5.8	5.7	6.0	5.5	6.0	5.7	5.7	6.0	6.0	5.6	5.9	5.8	5.7	5.7
Inspect	Fabrication inspection per drawing performed on all specimens - R. J. Bradley.														
Quality Assur.	Bondline thickness, ultrasonic C-scan and x-ray inspection - R. E. Shupe.														

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

PHASE I - CONFIGURATION B

Specimen No. ID-	111C01	111A01	111D01	111A02	111C02	111D02	111C03	111D03	111A04	(Cont.)	111C04	111D04	111C05	111A05
NO #7226-13021B	.A01	.A02	.A03	.A04	.A05	.A06	.A07	.A08	.A09	.A10	.A11	.A12	.A13	.A14
Core Joint Thickness	.085	.085	.0855	.084	.085	.085	.084	.084	.0845	.0845	.0845	.085	.084	.084
Core Material	T.													
Core Thickness	.086	.086	.086	.086	.086	.086	.086	.086	.0865	.0865	.0865	.086	.086	.086
Step 1	.0584	.0587	.0592	.0586	.0590	.0590	.0597	.0600	.0587	.0590	.0595	.0585	.0575	.0560
" 2	.0569	.0407	.0400	.0354	.0384	.0350	.0405	.0375	.0390	.0390	.0380	.0395	.0370	.0355
" 3	.0375	.0380	.0380	.0380	.0380	.0380	.0370	.0365	.0380	.0380	.0370	.0380	.0370	.0360
Bondline Thickness														
Step 1	5.2	4.2	4.2	4.5	4.4	3.8	4.5	4.5	4.5	4.3	4.7	4.0	4.5	4.3
" 2	5.1	4.5	4.5	4.5	4.3	4.5	4.0	4.0	5.0	4.0	3.8	4.3	4.8	4.5
" 3	4.5	4.0	4.0	4.3	3.8	4.5	4.5	4.5	4.3	4.0	4.0	4.0	4.0	4.9
Step Length														
Step 1	.509	.502	.509	.511	.510	.503	.506	.507	.489	.488	.491	.493	.500	.500
" 2	.501	.500	.494	.498	.491	.494	.490	.486	.510	.509	.508	.508	.505	.506
" 3	.513	.495	.512	.507	.503	.492	.504	.505	.509	.512	.517	.520	.495	.500
Adhesive / Wt.	BA9601/.045													
Adh. Batch / Roll	364-65 / 7													
Layup Time	1000													
Layup Date	12/18/70													
Cure Time	1300													
Cure Date	12/18/70													
Cure Pressure	85													
Heatup Rate (°F/MIN)	6													
Total Cure Time/Temp	120/350													
LDR No.	428783													
Inspection	Fabrication inspection per drawing performed on all specimens - R. J. Bradley													
Quality Assur.	Bondline thickness, ultrasonic C-scan and X-ray inspections - R. E. Shupe													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I - CONFIGURATION B
BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

Specimen No., ID-	111A06	111C06	111D06	111C07	(Cont.)	111A07	111D05	111A08	111C08	111D08	111C09	(Cont.)	111A09	111D07	111A10	111C10
DWG #7886-130215	1A17	1A18	1A19	1A20	1A21	1A22	1A23	1A24	1A25	1A26	1A27	1A28	1A29	1A30	1A31	1A32
Composite Thickness	.0845	.085	.085	.0855	.0845	.0845	.0845	.0845	.084	.0845	.084	.0845	.0845	.0845	.0845	.085
Metal Material	71															
Metal Thickness	.086	.0855	.086	.086	.086	.0855	.085	.085	.085	.086	.0865	.0865	.087	.087	.0855	.0855
Step 1	.0619	.0725	.0610	.0595	.0600	.0615	.0615	.0505	.0695	.0619	.0615	.0615	.0625	.0625	.0620	.0619
Step 2	.0377	.0373	.0380	.0385	.0380	.0380	.0378	.0370	.0390	.0499	.0410	.0405	.0415	.0405	.0405	.0410
Step 3	.0170	.0180	.0173	.0190	.0180	.0182	.0175	.0170	.0133	.0170	.0180	.0180	.0185	.0185	.0190	.0170
Bondline Thickness																
Step 1	3.5	3.9	3.9	4.7	3.5	4.0	3.6	4.4	4.0	4.2	4.7	3.8	4.6	4.3	4.7	4.3
Step 2	3.9	3.9	3.5	4.4	3.5	3.8	4.3	4.4	3.7	5.0	4.0	4.2	3.7	4.2	4.2	3.6
Step 3	3.8	4.2	4.0	3.7	4.4	5.0	4.2	4.0	4.0	5.9	3.7	4.4	3.7	4.0	4.5	4.0
Step Length -																
Step 1	.507	.508	.510	.511	.512	.514	.516	.516	.503	.505	.502	.500	.502	.501	.500	.497
Step 2	.486	.487	.486	.486	.486	.487	.484	.484	.500	.498	.497	.497	.493	.493	.494	.496
Step 3	.511	.511	.510	.509	.512	.507	.512	.515	.492	.499	.499	.493	.488	.487	.487	.485
Adhesive / Mt.	EA801/045															
Batch / Roll	304-657															
Layup Time	1000															
Layup Date	12/18/70															
Cure Time	1300															
Cure Date	12/18/70															
Cure Pressure	85															
Rent up Rate (°/Min)	6															
Total Cure Time/Temp	120/350															
L.D.R. No	428783															
Inspection	Fabrication inspection per drawing performed on all specimens - R. J. Bradley															
Quality Assur.	Bondline thickness, ultrasonic C-scan and X-ray inspections - R. E. Shupe															

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE AG
PAGE 3

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG														
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER														
Specimen No. ID -	511A01	511A02	511D01	511A03	511A04	511A05	511A06	511A07	511A08	511D03	511A09	511A10	PHASE I - CONFIGURATION B	
DWG #7226-1802B -	1A41	1A42	1A43	1A44	1A45	1A46	1A47	1A48	1A49	1A50	1A51	1A52	1A53	
Composite Thickness	.0845	.0845	.0845	.0845	.0845	.0845	.0845	.0845	.0845	.0845	.0845	.0845	.0845	
Metal Material	Ti													
Metal Thickness	.084	.084	.084	.084	.084	.084	.084	.084	.084	.084	.084	.084	.084	
Step 1	.058	.060	.060	.059	.058	.058	.058	.058	.058	.058	.058	.058	.058	
Step 2	.036	.037	.036	.037	.037	.037	.037	.037	.037	.037	.037	.037	.037	
Step 3	.017	.018	.016	.017	.017	.017	.018	.018	.030	.030	.030	.030	.030	
Bondline Thickness														
Step 1									5.5	5.5	5.5	5.5	5.5	
Step 2									6.0	5.9	6.0	6.0	6.0	
Step 3									5.5	5.4	5.5	5.5	5.5	
Step Length														
Step 1									.506	.507	.508	.505	.511	
Step 2									.487	.500	.501	.500	.506	
Step 3									.502	.505	.509	.510	.510	
Adhesive / wt	EA9601/045								EA9601/045					
Batch / Roll	34-0154/4								383-103 EE					
Layup Time	1:00								1600					
Layup Date	2/2/71								7/16/71					
Cure Time	2:00								1045					
Cure Date	2/3/71								1/19/71					
Cure Pressure	30								85					
Heatup Rate ($^{\circ}$ /Min.)									4.4					
Total Cure Time/Temp	120/350								120/350					
L.D.R. No.	42734								428276					
Inspection	Fabrication inspection per drawing performed on all specimens - R. J. Bradley													
Quality Assur.	Bondline thickness, ultrasonic C-scan and X-ray inspection - R. E. Shupe													

PHASE I - CONFIGURATION B

PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

[illegible]

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER

PHASE I - CONFIGURATION B

Specimen No. ID	(Cont.)	211A01	211A02	211A03	211A04	211A05	(Cont.)	211D02	211A06	211A07	211A08	211D03	211A09	211A10			
INSTRUMENTED		5A01	5A02	5A03	5A04	5A05	5A06	5A07	5A08	5A09	5A10	5A11	5A12	5A13	5A14	5A15	5A16
Composite Thickness		.0825	.0825	.0825	.083	.083	.083	.083	.083	.083	.083	.083	.083	.0825	.083	.083	.083
Metal Material	Ti																
Metal Thickness		.088	.088	.088	.0875	.087	.087	.086	.086	.086	.0855	.085	.085	.085	.0845	.0835	
Step 1		.059	.059	.060	.059	.059	.058	.058	.058	.059	.058	.059	.058	.059	.059	.059	
Step 2		.038	.038	.038	.039	.038	.037	.037	.037	.038	.038	.037	.038	.037	.037	.038	
Step 3 (1)		.019	.019	.019	.019	.019	.019	.019	.019	.019	.019	.019	.019	.019	.019	.019	
Bondline Thickness																	
Step 1		3.7	3.7	3.7	3.5	3.7	3.8	3.6	3.7	3.6	3.6	3.5	3.5	3.8	3.5	3.5	3.6
Step 2		3.7	3.3	3.3	3.6	3.7	4.0	3.5	3.6	3.6	3.6	3.6	3.7	3.6	3.6	3.8	3.7
Step 3		4.14	4.16	4.14	4.15	4.14	4.16	3.3	3.3	3.8	4.2	4.2	4.5	4.0	4.0	4.5	4.5
Step Length																	
Step 1		.500	.504	.502	.504	.500	.501	.500	.502	.501	.500	.503	.501	.500	.500	.502	.500
Step 2		.487	.490	.486	.486	.490	.488	.487	.488	.487	.490	.485	.485	.487	.490	.485	.487
Step 3		.518	.518	.519	.518	.516	.518	.517	.518	.519	.517	.513	.525	.517	.518	.518	.518
Adhesive / Wt	210601/045																
Batch / Roll	64-158/4																
Layup Time	0830																
Layup Date	2/5/71																
Cure Time	15L																
Cure Date	2/5/71																
Cure Pressure	90																
Heat-Up Rate (°F/Min)	7																
Cure Time-Total/Temp	120/360																
L.H.B. No.	412795																
Inspection	Fabrication inspection per drawing performed on all specimens - H. J. Bradley																
Quality Assur.	Bondline thickness, ultrasonic scan and X-ray inspections - H. E. Strape																
(1)	See 3 Metal Thickness .001" over tolerance																

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL TABLE A6
PAGE _____

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG															
PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER															
PHASE I - CONFIGURATION B															
Specimen No. JB	311A01	311A02	311A03	311A04	311A05	311A06	311A07	311A08	311A09	311A10	311A11	311A12	311A13	311A14	311A15
DWG #226-1102 JB	9A01	9A02	9A03	9A04	9A05	9A06	9A07	9A08	9A09	9A10	9A11	9A12	9A13	9A14	9A15
Composite Thickness	.085	.0855	.0855	.086	.085	.085	.085	.0845	.0855	.0855	.0855	.0855	.0855	.0855	.085
Metal Material	T1														
Metal Thickness	.085	.086	.087	.087	.0875	.088	.088	.084	.084	.084	.0845	.0845	.084	.0845	.084
Step 1	.060	.060	.060	.061	.060	.061	.061	.060	.060	.060	.060	.060	.060	.060	.060
Step 2	.039	.039	.039	.040	.039	.040	.040	.039	.039	.039	.039	.039	.039	.039	.039
Step 3	.017	.017	.019	.017	.017	.017	.017	.018	.018	.018	.018	.018	.016	.017	.018
Bondline Thickness															
Step 1	4.6	4.1	4.3	4.5	4.7	4.3	3.5	4.3	4.7	3.6	4.2	3.6	4.5	3.6	4.5
Step 2	3.7	4.0	3.9	4.5	4.0	3.8	4.2	4.0	4.2	3.5	3.8	4.2	4.2	4.2	4.0
Step 3	4.2	4.0	4.2	4.7	4.5	4.2	4.7	4.4	3.5	3.7	4.4	4.2	4.0	4.5	3.9
Step Length															
Step 1	.339	.345	.349	.354	.356	.360	.365	.369	.367	.369	.368	.365	.369	.363	.365
Step 2	.373	.373	.370	.367	.368	.368	.364	.375	.380	.381	.377	.373	.375	.373	.385
Step 3	.394	.393	.394	.397	.396	.400	.402	.392	.395	.393	.397	.398	.390	.390	.394
Adhesive /wt	EA9601	.045													
Batch / Roll	304-159/2														
Layup Time	0930														
Layup Date	2/5/71														
Cure Time	1512														
Cure Date	2/5/71														
Cure Pressure	90														
Heat-Up Rate (°F/min)	7														
Cure Time-Total/Temp	120/360														
L.D.R. No.	412795														
Inspection	Fabrication inspection														
Quality Assur.	Bondline thickness, ultrasonic C-scan and X-Ray inspections - R. E. Shupe														

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE _____

TABLE A7
1

MECHANICAL JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PHASE I - CONFIGURATION B

DWG #	7226-1302E-	LA01	LA22	LA03	LA04	LA05	LA06	LA07	LA08	LA09	LA10	LA11	LA12	LA13	LA14	LA15	LA16	LA17	LA18	LA19	LA20
Specimen No. IE-	111C01	111A01	111A02	511A01	111B01	111C02	111C03	61	111A03	111B02	111A04	(Cont)	111D01	111D03	511A05	611F04	611F03	511A06	111C06	111B03	111A05
Panel Identification	Exp 310																				
Adherend Thickness																					
Panic	.046	.047	.047	.0465	.0475	.0475	.047	.0475	.048	.047	.047	.047	.047	.036	.046	.0465	.045	.0465	.047	.046	.044
1st Build Up	.070	.0695	.0705	.0695	.069	.0695	.070	.069	.069	.070	.0695	.0695	.0695	.0685	.0695	.067	.0675	.069	.068	.0675	.067
2nd Build Up	.093	.093	.093	.0935	.093	.0935	.093	.0935	.0935	.0935	.094	.0935	.0935	.088	.0925	.092	.0925	.093	.0905	.0905	.0905
3rd Build Up	NA																				
4th Build Up	NA																				
Splice Material	Ti-8-1-1																				
Splice Thickness	.126																				
Metal Joint Half	Ti-8-1-1																				
Fastener Torque	30 in.-lbs.																				
Fay Surface Sealant	111-B2																				
Batch No.	Crib Mix																				
DWG NO. 7226-1302E	LA21	LA22	LA23	LA24	LA25	LA26	LA27	LA28	LA29	LA30	LA31	LA32	LA33	LA33	LA34	LA35	LA36	LA37	LA38	LA39	LA40
Specimen No. IE-	111B04	111C04	511A03	111A06	111B02	611G03	111C05	111B05	111B06	611F05	111A07	511A04	111D03	511A05	611F04	611F03	511A06	111C06	111C06	111B03	111A07
Panel Identification	Exp 310																				
Adherend Thick (in)																					
Panic	.046	.046	.0465	.0465	.0455	.046	.048	.0475	.047	.0475	.048	.047	.0465	.047	.047	.047	.0485	.047	.0465	.0475	.046
1st Build Up	.0665	.0635	.0675	.0675	.0655	.068	.067	.0685	.0665	.068	.0665	.067	.0675	.065	.068	.070	.068	.068	.067	.068	.068
2nd Build Up	.0895	.0895	.088	.0895	.088	.090	.091	.0935	.092	.093	.0935	.0935	.093	.0945	.0935	.093	.0935	.0935	.0925	.0925	.092
3rd Build Up	NA																				
4th Build Up	NA																				
Splice Material	Ti-8-1-1																				
Splice Thickness	.126																				
Metal Joint Half	Ti-8-1-1																				
Fastener Torque	30 in.-lbs.																				
Fay Surface Sealant	111-B2																				
Batch No.	Crib Mix																				

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE A7
MODEL 2
PAGE

MECHANICAL JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PHASE I - CONFIGURATION 2

MECHANICAL JOINT SPECIMENS - FABRICATION AND INSPECTION LOG																					
PHASE I - CONFIGURATION 2																					
FIG. NO.	7226-1302IE	1A41	1A42	1A43	1A44	1A45	1A46	1A47	1A48	1A49	1A50	1A51	1A52	1A53	1A54	1A55	1A56	1A57	1A58	1A59	1A60
Specimen No. IE-	511A03	(Lost)	611P06	111A08	111D04	111A09	611G02	111B07	611G06	111C09	111A10	511A09	611P07	(Lost)	611G04	111A11	111D05	(Cont)	111B08	111C05	
Panel Identification	IE210318B											IE210318C									
Adherent Thick (in)																					
Basic	.047		.047	.046	.047	.046	.046	.048	.046	.046	.046	.046	.046	.046	.047	.047	.047	.047	.046	.047	
1st Build Up	.066		.045	.066	.065	.063	.066	.065	.065	.068	.065	.056	.065	.066	.068	.067	.067	.066	.068	.066	
2nd Build Up	.051		.091	.086	.087	.090	.091	.091	.091	.091	.090	.093	.095	.094	.090	.094	.094	.093	.094	.091	
Splice Material	8-1-1																				
Splice Thickness	.126																				
Metal Joint Half	8-1-1 W																				
Fay Surface Sealant	STM 40	11-82																			
Batch No.	54639																				
Collar Torque	30 in.-lbs.																				
FIG. NO. <th>7226-1302IE</th> <th>1A61</th> <th>1A62</th> <th>1A63</th> <th>1A64</th> <th>1A65</th> <th>1A66</th> <th>1A67</th> <th>1A68</th> <th>1A69</th> <th>1A70</th> <th>1A71</th> <th>1A72</th> <th>1A73</th> <th>1A74</th> <th>1A75</th> <th>1A76</th> <th>1A77</th> <th>1A78</th> <th>1A79</th>	7226-1302IE	1A61	1A62	1A63	1A64	1A65	1A66	1A67	1A68	1A69	1A70	1A71	1A72	1A73	1A74	1A75	1A76	1A77	1A78	1A79	
Specimen No. IE	511A12	511A10	111B09	111A13	211D01	211A01	211A04	211A02	211A05	211A06	211B02	211D03	211B03	211B04	211A03	211B05	211D05				
Panel Identification	IE210318C				IE250318																
Adherent Thickness																					
Basic	.047	.047	.047	.047	.046	.045	.046	.045	.045	.044	.045	.046	.045	.045	.045	.045	.045	.045	.045	.045	
1st Build Up	.064	.066	.067	.072	.0605	.055	.052	.054	.055	.051	.051	.053	.045	.055	.056	.055	.055	.055	.055	.055	
2nd Build Up	.082	.080	.080	.095	.065	.0655	.065	.065	.065	.065	.065	.0655	.065	.0655	.066	.0655	.065	.0655	.0655	.0655	
Splice Material	Ti-8-1-1																				
Splice Thickness	.126																				
Metal Joint Half	Ti-8-1-1																				
Fastener Torque	30 in.-lbs.																				
Fay Surface Sealant	111-82																				
Batch No.	54639																				

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

MECHANICAL JOINT SPECIMENS - FABRICATION AND INSPECTION LOG

PHASE I - CONFIGURATION E

DWG. NO.	7226-1302IE	7A01	7A02	7A03	7A04	7A05	7A06	7A07	7A08	7A09	9A01	9A02	9A03	9A04	9A05	9A06	9A07	9A08	9A09
Specimen No. IE-	311A01	311D01	311A02	(Cont)	311D02	311A03	311A04	311D03	311A05	311D04	321A01	321D01	321A02	321D02	321A03	321D03	321A04	321D04	321A05
Panel Identification	IE21031BC	IE21031BD									IE25031E								
Adherend Thick (in)																			
Basic	.046	.045	.046	.047	.046	.047	.047	.047	.047	.047	.045	.045	.045	.045	.044	.044	.045	.045	.045
1st Build Up	.070	.070	.069	.069	.070	.071	.071	.070	.070	.070	.062	.055	.055	.055	.055	.055	.055	.054	.056
2nd Build Up	.094	.093	.091	.091	.093	.093	.093	.093	.093	.093	.0655	.066	.066	.064	.0655	.066	.066	.066	.0655
Splice Material	TI-8-1-1																		
Splice Thickness	0.126"																		
Metal Joint Half	TI-8-1-1																		
Fastener Torque	30 in.-lbs.																		
Pay Surface Seal	STM 40 112-82																		
Batch No.	Crib MK																		
DWG. NO. 7226-1302IE	11A01	11A02	11A03	11A04	11A05	11A06	11A07	11A08	11A09	11A09	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09
Specimen No. IE-	411A01	411D01	411A02	411A03	411D02	411A04	411D03	411D03	411A05	411A05	421A01	421D01	421A02	421A03	421D02	421A04	421D04	421A05	421D05
Panel Identification	IE27031E										IE24031E								
Adherend Thick (in)																			
Basic	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045	.045
1st Build Up	.105	.107	.106	.105	.105	.107	.105	.106	.105	.105	.087	.090	.089	.090	.088	.085	.090	.089	.090
2nd Build Up	.128	.129	.128	.129	.128	.126	.127	.127	.126	.126	.103	.102	.100	.101	.103	.101	.103	.102	.103
3rd Build Up	.149	.148	.148	.148	.148	.146	.147	.148	.148	.148	.106	.106	.105	.104	.105	.104	.107	.104	.106
4th Build Up	.171	.170	.170	.170	.169	.170	.168	.170	.169	.168	.123	.124	.123	.123	.125	.123	.124	.123	.123
Splice Material	TI-8-1-1																		
Splice Thickness	.242																		
Metal Joint Half	TI-8-1-1																		
Fastener Torque	10 in.-lbs.																		
Pay Surface Sealant	STM 40 111-132																		
Batch No.	94278																		

MECHANICAL JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PHASE I - CONFIGURATION 2:

[illegible]

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

MECHANICAL JOINT SPECIMENS - FABRICATION AND INSPECTION LOG

PHASE I - CONFIGURATION B

FIG. NO.	1801	1802	1803	1804	1805	1806	1807	1808	1809	1810	1811	1812	1813	1814
Specimen No. 12-	112A01	112D01	(Cont)	112A02	112D02	112A03	112A04	112D03	112A05					
Panel Identification	1221031BC	15-23												
Assembly Thick (in)	.046	.047	.047	.048	.047	.047	.047	.048	.046					
Basic	.072	.072	.072	.072	.072	.072	.070	.070	.049					
1st Build Up	.096	.096	.095	.096	.095	.096	.095	.094	.093					
2nd Build Up														
Splice Material	1221031B													
Splice Thickness	.094	.094	.094	.094	.093	.094	.094	.094	.094					
Metal Joint Half	.126	.126	.126	.126	.126	.126	.126	.126	.126					
Fastener Torque	30 in.-lbs.													
Ray Surface Sealant	STM 40 111-B2													
Batch No.	54619													
FIG. NO.	122A01	122A02	122D01	122A03	122A04	122A05	122D02	122A06	122A07	122A08	122D03	122A09	122A10	
Specimen No. 12-	122A01	122A02	122D01	122A03	122A04	122A05	122D02	122A06	122A07	122A08	122D03	122A09	122A10	
Panel Identification	122301B													
Assembly Thick (in)	.045	.046	.046	.045	.043	.045	.045	.046	.045	.045	.045	.045	.045	
Basic	.071	.071	.071	.070	.068	.072	.071	.070	.072	.071	.071	.072	.072	
1st Build Up	.088	.088	.088	.088	.086	.089	.089	.090	.090	.090	.091	.091	.091	
2nd Build Up														
Splice Material	122301B													
Splice Thickness	.097	.097	.097	.097	.097	.097	.094	.097	.099	.095	.097	.095	.095	
Metal Joint Half	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	
Fastener Torque	30 in.-lbs.													
Ray Surface Sealant	STM 40 111-B2													
Batch No.	54619													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

MECHANICAL JOINT SPECIMEN - FABRICATION AND INSPECTION LOG

PHASE I - CONFIGURATION F

DMG # 7226-13021F-	1A01	1A02	1A03	1A04	1A05	1A06	1A07	1A08	1A09	1A10	1A11	1A12	1A13	1A14
Specimen Number JF	111A01	111A02	111D01	111A03	111A04	111A05	111A11	111D02	111A06	111A07	111A08	111D03	111A09	111A10
Panel Identification	IF1A086													
Adherend Thick (in)														
Basic	.043	.043	.045	.043	.043	.043	.043	.044	.044	.044	.045	.043	.043	.043
Total	.034	.034	.034	.034	.034	.034	.034	.035	.035	.035	.035	.034	.034	.034
Stitch Material/Thick	Ti/012													
Number of Stitches	2													
Adhesive Type/Vis.	EA9601/.045													
Batch / Pot	383-103/EE													
Layup-Time	1300													
Layup Date	3/3/71													
Cure Time - Start	1540													
Cure Date	8/4/71													
Cure Pressure	85													
Heat Up Rate (°F/Min)	4													
Cure Test Time/Temp	135/350													
L.D.R. No.	382382													
Ray Surface Sealant	STM 40													
	112-812													
Batch No.	Crib Mix													
Application Date	9/3/71													
Torque Application	30 in-lbs													
Torque - 30 Min.	30 in-lbs													
Cure Temp	140°F													
Cure Time	48 Hrs													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. 7226-802IF
MODEL TABLE A/B
PAGE 2

MECHANICAL JOINT SPECIMEN - FABRICATION AND INSPECTION LOG
PHASE I - CONFIGURATION F

DWG No. 7226-802IF	3A01	3A02	3A03	3A04	3A05	3A06	3A07	3A08	3A09
Specimen Number IF - 411A01	411A01	411D01	411A02	(Cont.)	411D02	411A03	411A04	411D03	411A05
Panel Identification IF1A0804									
Adherend Thick (in)									
Basic	.084	.083	.083	.083	.083	.083	.083	.083	.084
Total	.170	.170	.170	.171	.171	.171	.170	.170	.169
Shim Material/Thick	11/.012								
Number of Shims	4								
Adhesive Type/Wt	EA9601/.045								
Batch/Roll	383-108/EE								
Layup Time	1300								
Layup Date	8/3/71								
Cure Time - Start	1540								
Cure Date	8/4/71								
Cure Pressure psi	85								
Heat up Rate (°F/Min)	4								
Cure Time/Temp	135/350								
I.D.R. No.	382382								
Fay Surface Sealant	112-112								
Batch No.	Crib Mix								
Application Time	10:00								
Application Date	9/3/71								
Torque-Ac Application	70 in-lbs.								
Torque - At 30 Mts	70 in-lbs								
Cure Temp	140°F								
Cure Time	48 hrs								
Cure Date (Cos.)	9/9/71								

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE A9
MODEL 1
PAGE

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG

PHASE II - CONFIGURATION A

	LA11	LA02	LA03	LA04	LA05	LA06	LA07	LA08	LA09	LA10	LA11	LA12	LA13	LA14	LA15	LA16	LA17	LA18	LA19	LA20
DWG 7226-1302IA-IIA	11D01	21A01	11A01	11D04	11A02	11C01	41P01	11C02	41P02	21A02	11A03	11A04	21A03	11D02	11D05	11C03	41P03	11A06	11C04	11A07
Specimen No. IIA																				
Panel Identification	IIA0210																			
Splice Material	T1																			
Splice Thickness	.040																			
Specimen Material	Boron																			
Specimen Thickness	0.45																			
Bondline Thickness																				
Left	5.7	5.3	5.4	4.8	5.6	5.6	5.6	5.1	5.3	5.6	5.4	5.1	5.1	5.7	5.7	5.5	5.5	5.6	5.3	5.5
Right	5.0	4.7	5.0	5.4	5.6	5.3	5.3	5.0	5.6	5.4	5.7	5.1	5.0	5.6	5.5	5.0	5.1	5.6	5.7	5.5
Adhesive Type/No.	EA9601/06																			
Batch/Roll	383-5/JP												1100							
Layup Time	1300												2/22/71							
Layup Date	2/13/71												1023							
Cure Time Start	1327												2/23/71							
Cure Date	2/19/71												30							
Cure Pressure (PSI)	30												5.75							
Heat Up Rate (°F/min)	7.8												78/260							
Cure Time/Temp.	73/260												412799							
L.D.R. No.	412798																			

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PHASE II - CONFIGURATION A

Specimen No. - IIA	11A08	11A09	11A10	11A11	11A12	11A13	11A14	11A15	11A16	11A17	11A18	11A19	11A20	11A21	11A22	11A23	11A24	11A25	11A26	11A27	11A28	11A29	11A30	11A31	11A32	11A33	11A34	11A35	11A36	11A37	11A38	11A39	11A40	11A41	11A42	11A43	11A44	11A45	11A46	11A47	11A48	11A49	11A50	11A51	11A52	11A53	11A54	11A55	11A56	11A57	11A58	11A59	11A60	11A61	11A62	11A63	11A64	11A65	11A66	11A67	11A68	11A69	11A70	11A71	11A72	11A73	11A74	11A75	11A76	11A77	11A78	11A79	11A80	11A81	11A82	11A83	11A84	11A85	11A86	11A87	11A88	11A89	11A90	11A91	11A92	11A93	11A94	11A95	11A96	11A97	11A98	11A99	11A100	11A101	11A102	11A103	11A104	11A105	11A106	11A107	11A108	11A109	11A110	11A111	11A112	11A113	11A114	11A115	11A116	11A117	11A118	11A119	11A120	11A121	11A122	11A123	11A124	11A125	11A126	11A127	11A128	11A129	11A130	11A131	11A132	11A133	11A134	11A135	11A136	11A137	11A138	11A139	11A140	11A141	11A142	11A143	11A144	11A145	11A146	11A147	11A148	11A149	11A150	11A151	11A152	11A153	11A154	11A155	11A156	11A157	11A158	11A159	11A160	11A161	11A162	11A163	11A164	11A165	11A166	11A167	11A168	11A169	11A170	11A171	11A172	11A173	11A174	11A175	11A176	11A177	11A178	11A179	11A180	11A181	11A182	11A183	11A184	11A185	11A186	11A187	11A188	11A189	11A190	11A191	11A192	11A193	11A194	11A195	11A196	11A197	11A198	11A199	11A200	11A201	11A202	11A203	11A204	11A205	11A206	11A207	11A208	11A209	11A210	11A211	11A212	11A213	11A214	11A215	11A216	11A217	11A218	11A219	11A220	11A221	11A222	11A223	11A224	11A225	11A226	11A227	11A228	11A229	11A230	11A231	11A232	11A233	11A234	11A235	11A236	11A237	11A238	11A239	11A240	11A241	11A242	11A243	11A244	11A245	11A246	11A247	11A248	11A249	11A250	11A251	11A252	11A253	11A254	11A255	11A256	11A257	11A258	11A259	11A260	11A261	11A262	11A263	11A264	11A265	11A266	11A267	11A268	11A269	11A270	11A271	11A272	11A273	11A274	11A275	11A276	11A277	11A278	11A279	11A280	11A281	11A282	11A283	11A284	11A285	11A286	11A287	11A288	11A289	11A290	11A291	11A292	11A293	11A294	11A295	11A296	11A297	11A298	11A299	11A300	11A301	11A302	11A303	11A304	11A305	11A306	11A307	11A308	11A309	11A310	11A311	11A312	11A313	11A314	11A315	11A316	11A317	11A318	11A319	11A320	11A321	11A322	11A323	11A324	11A325	11A326	11A327	11A328	11A329	11A330	11A331	11A332	11A333	11A334	11A335	11A336	11A337	11A338	11A339	11A340	11A341	11A342	11A343	11A344	11A345	11A346	11A347	11A348	11A349	11A350	11A351	11A352	11A353	11A354	11A355	11A356	11A357	11A358	11A359	11A360	11A361	11A362	11A363	11A364	11A365	11A366	11A367	11A368	11A369	11A370	11A371	11A372	11A373	11A374	11A375	11A376	11A377	11A378	11A379	11A380	11A381	11A382	11A383	11A384	11A385	11A386	11A387	11A388	11A389	11A390	11A391	11A392	11A393	11A394	11A395	11A396	11A397	11A398	11A399	11A400	11A401	11A402	11A403	11A404	11A405	11A406	11A407	11A408	11A409	11A410	11A411	11A412	11A413	11A414	11A415	11A416	11A417	11A418	11A419	11A420	11A421	11A422	11A423	11A424	11A425	11A426	11A427	11A428	11A429	11A430	11A431	11A432	11A433	11A434	11A435	11A436	11A437	11A438	11A439	11A440	11A441	11A442	11A443	11A444	11A445	11A446	11A447	11A448	11A449	11A450	11A451	11A452	11A453	11A454	11A455	11A456	11A457	11A458	11A459	11A460	11A461	11A462	11A463	11A464	11A465	11A466	11A467	11A468	11A469	11A470	11A471	11A472	11A473	11A474	11A475	11A476	11A477	11A478	11A479	11A480	11A481	11A482	11A483	11A484	11A485	11A486	11A487	11A488	11A489	11A490	11A491	11A492	11A493	11A494	11A495	11A496	11A497	11A498	11A499	11A500	11A501	11A502	11A503	11A504	11A505	11A506	11A507	11A508	11A509	11A510	11A511	11A512	11A513	11A514	11A515	11A516	11A517	11A518	11A519	11A520	11A521	11A522	11A523	11A524	11A525	11A526	11A527	11A528	11A529	11A530	11A531	11A532	11A533	11A534	11A535	11A536	11A537	11A538	11A539	11A540	11A541	11A542	11A543	11A544	11A545	11A546	11A547	11A548	11A549	11A550	11A551	11A552	11A553	11A554	11A555	11A556	11A557	11A558	11A559	11A560	11A561	11A562	11A563	11A564	11A565	11A566	11A567	11A568	11A569	11A570	11A571	11A572	11A573	11A574	11A575	11A576	11A577	11A578	11A579	11A580	11A581	11A582	11A583	11A584	11A585	11A586	11A587	11A588	11A589	11A590	11A591	11A592	11A593	11A594	11A595	11A596	11A597	11A598	11A599	11A600	11A601	11A602	11A603	11A604	11A605	11A606	11A607	11A608	11A609	11A610	11A611	11A612	11A613	11A614	11A615	11A616	11A617	11A618	11A619	11A620	11A621	11A622	11A623	11A624	11A625	11A626	11A627	11A628	11A629	11A630	11A631	11A632	11A633	11A634	11A635	11A636	11A637	11A638	11A639	11A640	11A641	11A642	11A643	11A644	11A645	11A646	11A647	11A648	11A649	11A650	11A651	11A652	11A653	11A654	11A655	11A656	11A657	11A658	11A659	11A660	11A661	11A662	11A663	11A664	11A665	11A666	11A667	11A668	11A669	11A670	11A671	11A672	11A673	11A674	11A675	11A676	11A677	11A678	11A679	11A680	11A681	11A682	11A683	11A684	11A685	11A686	11A687	11A688	11A689	11A690	11A691	11A692	11A693	11A694	11A695	11A696	11A697	11A698	11A699	11A700	11A701	11A702	11A703	11A704	11A705	11A706	11A707	11A708	11A709	11A710	11A711	11A712	11A713	11A714	11A715	11A716	11A717	11A718	11A719	11A720	11A721	11A722	11A723	11A724	11A725	11A726	11A727	11A728	11A729	11A730	11A731	11A732	11A733	11A734	11A735	11A736	11A737	11A738	11A739	11A740	11A741	11A742	11A743	11A744	11A745	11A746	11A747	11A748	11A749	11A750	11A751	11A752	11A753	11A754	11A755	11A756	11A757	11A758	11A759	11A760	11A761	11A762	11A763	11A764	11A765	11A766	11A767	11A768	11A769	11A770	11A771	11A772	11A773	11A774	11A775	11A776	11A777	11A778	11A779	11A780	11A781	11A782	11A783	11A784	11A785	11A786	11A787	11A788	11A789	11A790	11A791	11A792	11A793	11A794	11A795	11A796	11A797	11A798	11A799	11A800	11A801	11A802	11A803	11A804	11A805	11A806	11A807	11A808	11A809	11A810	11A811	11A812	11A813	11A814	11A815	11A816	11A817	11A818	11A819	11A820	11A821	11A822	11A823	11A824	11A825	11A826	11A827	11A828	11A829	11A830	11A831	11A832	11A833	11A834	11A835	11A836	11A837	11A838	11A839	11A840	11A841	11A842	11A843	11A844	11A845	11A846	11A847	11A848	11A849	11A850	11A851	11A852	11A853	11A854	11A855	11A856	11A857	11A858	11A859	11A860	11A861	11A862	11A863	11A864	11A865	11A866	11A867	11A868	11A869	11A870	11A871	11A872	11A873	11A874	11A875	11A876	11A877	11A878	11A879	11A880	11A881	11A882	11A883	11A884	11A885	11A886	11A887	11A888	11A889	11A890	11A891	11A892	11A893	11A894	11A895	11A896	11A897	11A898	11A899	11A900	11A901	11A902	11A903	11A904	11A905	11A906	11A907	11A908	11A909	11A910	11A911	11A912	11A913	11A914	11A915	11A916	11A917	11A918	11A919	11A920	11A921	11A922	11A923	11A924	11A925	11A926	11A927	11A928	11A929	11A930	11A931	11A932	11A933	11A934	11A935	11A936	11A937	11A938	11A939	11A940	11A941	11A942	11A943	11A944	11A945	11A946	11A947	11A948	11A949	11A950	11A951	11A952	11A953	11A954	11A955	11A956	11A957	11A958	11A959	11A960	11A961	11A962	11A963	11A964	11A965	11A966	11A967	11A968	11A969	11A970	11A971	11A972	11A973	11A974	11A975	11A976	11A977	11A978	11A979	11A980	11A981	11A982	11A983	11A984	11A985	11A986	11A987	11A988	11A989	11A990	11A991	11A992	11A993	11A994	11A995	11A996	11A997	11A998	11A999	11A1000	11A1001	11A1002	11A1003	11A1004	11A1005	11A1006	11A1007	11A1008	11A1009	11A1010	11A1011	11A1012	11A1013	11A1014	11A1015	11A1016	11A1017	11A1018	11A1019	11A1020	11A1021	11A1022	11A1023	11A1024	11A1025	11A1026	11A1027	11A1028	11A1029	11A1030	11A1031	11A1032	11A1033	11A1034	11A1035	11A1036	11A1037	11A1038	11A1039	11A1040	11A1041	11A1042	11A1043	11A1044	11A1045	11A1046	11A1047	11A1048	11A1049	11A1050	11A1051	11A1052	11A1053	11A1054	11A1055	11A1056	11A1057	11A1058	11A1059	11A1060	11A1061	11A1062	11A1063	11A1064	11A1065	11A1066	11A1067	11A1068	11A1069	11A1070	11A1071	11A1072	11A1073	11A1074	11A1075	11A1076	11A1077	11A1078	11A1079	11A1080	11A1081	11A1082	11A1083	11A1084	11A1085	11A1086	11A1087	11A1088	11A1089	11A1090	11A1091	11A1092	11A1093	11A1094	11A1095	11A1096	11A1097	11A1098	11A1099	11A1100	11A1101	11A1102	11A1103	11A1104	11A1105	11A1106	11A1107	11A1108	11A1109	11A1110	1
--------------------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. **TABLE A9**
MODEL **3**
PAGE

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG

PHASE II - CONFIGURATION A													
Specimen No. (1A-)	1A10	1A11	1A12	1A13	1A14	1A15	1A16	1C11	1C12	1C13	1C14		
Specimen No. (1A-)	1A10	1A11	1A12	1A13	1A14	1A15	1A16	1C11	1C12	1C13	1C14		
Panel Identification	1A0216	1A0216	1A0216	1A0216	1A0216	1A0216	1A0216	1A0216	1A0216	1A0216	1A0216		
Splicing Material	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI		
Splicing Material	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI	TI		
Specimen Material	Boron	Boron	Boron	Boron	Boron	Boron	Boron	Boron	Boron	Boron	Boron		
Specimen Thickness	.0435	.0435	.0435	.0435	.0435	.0435	.0435	.0435	.0435	.0435	.0435		
Bondline Thickness													
Left	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		
Right	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4		
Adhesive Type, etc.	9601/06	9601/06	9601/06	9601/06	9601/06	9601/06	9601/06	9601/06	9601/06	9601/06	9601/06		
Batch No.	383-5/72	383-5/72	383-5/72	383-5/72	383-5/72	383-5/72	383-5/72	383-5/72	383-5/72	383-5/72	383-5/72		
Lot No.	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000		
Inspection Date	3/23/71	3/23/71	3/23/71	3/23/71	3/23/71	3/23/71	3/23/71	3/23/71	3/23/71	3/23/71	3/23/71		
Inspection Time	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425	1425		
Inspection By	30	30	30	30	30	30	30	30	30	30	30		
Inspection Pressure	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7		
Inspection Rate (in/hr)	60/250	60/250	60/250	60/250	60/250	60/250	60/250	60/250	60/250	60/250	60/250		
Inspection Temp.	42857	42857	42857	42857	42857	42857	42857	42857	42857	42857	42857		
Inspection No.													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

BONDED JOINT SPEC. LENS - FABRICATION AND INSPECTION LOG
PHASE II - CONFIGURATION B

Specimen No. IIB	11001	11A01	11C01	11D02	11C02	11A02	11C03	11D03	11A03	11C04	11D04	11C05	11A05	11C06	11D06	31A05	(Case)
DAU No. 7226-11021B-IIB 1A01	1A01	1A02	1A03	1A04	1A05	1A06	1A07	1A08	1A09	1A10	1A11	1A12	1A14	1A15	1A16	1A17	1A18
Composite Thickness	.033	.083	.082	.083	.083	.083	.083	.083	.083	.083	.083	.083	.083	.083	.083	.081	.081
Metal Material:	T1																
Metal Thickness																	
Basic	.084	.084	.084	.086	.086	.085	.081	.081	.082	.083	.083	.083	.085	.085	.086	.086	.085
Step 1	.016	.017	.016	.016	.016	.016	.016	.016	.015	.016	.016	.017	.016	.016	.017	.017	.017
Step 2	.038	.038	.038	.039	.038	.038	.038	.038	.038	.038	.038	.038	.039	.038	.038	.039	.038
Step 3	.061	.061	.061	.060	.061	.061	.061	.061	.060	.061	.061	.060	.060	.061	.060	.060	.060
Bondline Thickness (mils)																	
Step 1	5.5	5.5	5.4	5.5	5.5	5.5	5.4	5.5	5.5	5.5	5.5	5.4	5.5	5.5	5.5	4.9	4.9
Step 2	6.0	6.0	6.0	5.9	6.0	5.9	5.9	6.0	6.0	5.9	6.0	5.9	6.0	6.0	6.0	5.0	5.0
Step 3	5.9	6.0	6.0	5.9	5.9	5.9	6.0	5.9	6.0	6.0	6.0	6.0	6.0	5.9	6.0	6.0	6.0
Step Length																	
Step 1	.525	.523	.534	.525	.525	.525	.523	.525	.525	.525	.525	.525	.525	.525	.525	.388	.388
Step 2	.509	.509	.509	.510	.509	.509	.509	.510	.510	.509	.509	.509	.509	.509	.509	.385	.385
Step 3	.515	.514	.515	.516	.516	.517	.516	.516	.516	.516	.516	.516	.515	.516	.516	.375	.376
Adhesive / Ac	9601/1045																
Batch / Roll	303-103/15																
Layup Time	1600																
Layup Date	7-16-73																
Cure Date	1345																
Cure Pressure (psi)	35																
Heatup Rate (°F/M)	4.4																
Cure - Total Time/Temp	130/350																
L.F.H. No.	42871b																

BONDED JOINT SPECIMEN: - FABRICATION AND INSPECTION LOG

229

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE _____

		PHASE II - CONFIGURATION E															
		METRIC JOINT SPECIMENS - FABRICATION AND INSPECTION LOG															
		PROGRAM PHASE AND SPECIMEN IDENTIFICATION NUMBER															
Specimen No.	Specimen No.	LA01	LA02	LA03	LA04	LA05	LA06	LA07	LA08	LA09	LA10	LA11	LA12	LA13	LA14	LA15	LA16
Panel Identification	Panel Identification	11LA01	11LA02	11LA03	11LA04	11LA05	11LA06	11LA07	11LA08	11LA09	11LA10	11LA11	11LA12	11LA13	11LA14	11LA15	11LA16
Adherent Thickness (in)	Adherent Thickness (in)	11E250804-1	11E250804-2	11E250804-3	11E250804-4	11E250804-5	11E250804-6	11E250804-7	11E250804-8	11E250804-9	11E250804-10	11E250804-11	11E250804-12	11E250804-13	11E250804-14	11E250804-15	11E250804-16
Basic	Basic	.043	.044	.045	.046	.047	.048	.049	.050	.051	.052	.053	.054	.055	.056	.057	.058
1st Build Up	1st Build Up	.059	.060	.061	.062	.063	.064	.065	.066	.067	.068	.069	.070	.071	.072	.073	.074
2nd Build Up	2nd Build Up	.075	.076	.077	.078	.079	.080	.081	.082	.083	.084	.085	.086	.087	.088	.089	.090
Filler Material	Filler Material	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Splice Thickness	Splice Thickness	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125
Metal Joint Half	Metal Joint Half	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1	T1
Metal Thickness	Metal Thickness	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125	.125
Fastener Torque	Fastener Torque	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.	30 in. lbs.
1st Surface Swell	1st Surface Swell	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012	3750 112-012
Batch No.	Batch No.	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix	Fit Mix
		(1) Fabricated for HLA08-B H-100 S/H for															

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE II - CONFIGURATION A

[illegible]

232

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

BONDED JOINT SPECIMENS - FABRICATION AND INSPECTION LOG
PHASE I - CONFIGURATION A - GRAPHITE

PHO NO. 7226-13021A	Q-1A	Q-2A	Q-3A	Q-4A	Q-5A	Q-6A	Q-7A	Q-8A	Q-9A	Q-10A	Q-11A	Q-12A	Q-13A	Q-14A
Specimen No.	E1A01	E1A02	E1D01	E1A03	E1A04	E1A05	E1D02	E1A06	E1A07	E1A08	E1D03	E1A09	E1A10	E1A10
Panel Identification	G1A1225													
Specimen Thickness	.055	.058	.057	.056	.059	.055	.057	.057	.054	.056	.057	.054	.056	.056
Specimen Material	Graphite													
Splice Material	TI													
Splice Thickness	.040													
Bondline Thickness														
Left (in)	3.6	4.0	4.0	3.0	4.0	4.0	5.0	5.0	3.0	4.0	5.0	3.5	4.0	4.0
Right (in)	3.0	4.0	4.0	4.0	4.0	5.0	4.0	4.5	5.0	4.0	5.0	3.5	4.0	4.0
Adhesive Type/ht	E1A901/.045													
Batch/roll	383-197/EE													
Layup Time	1606													
Layup Date	1-4-72													
Cure Time	10:0													
Cure Date	1-5-72													
Cure Pressure	30													
Heat-up Rate (°F/Min)	3.0													
Cure Temp/Time	250°F/4.0 Min													
I.D.R. No	431-005													
Composite Material Supplier	Fiberite Corp.													
Composite Material Designation	BY-2 B11B 904 Resin System													
Composite Material Batch & Roll	Lot #1083 Roll #1													
Layup Time	1000													
Layup Date	12-22-71													
Cure Time	0400													
Cure Date	12-23-71													
Heatup Rate	3-5°F/M													
Cure Temp/Time	375°F/4h													
I.D.R. No	441803													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 1

BONDED JOINT SPECIMEN-FABRICATION AND INSPECTION LOG
PWA-E 1 - CONFIGURATION A - 3-CLASS

Specimen No.	FG1A	FG2A	FG3A	FG4A	FG5A	FG6A	FG7A	FG8A	FG9A	FG10A	FG11A	FG12A	FG13A	FG14A
Panel Identification	E2A01	E2A02	E2A03	E2A04	E2A05	E2A06	E2A07	E2A08	E2A09	E2A10	E2A11	E2A12	E2A13	E2A14
Specimen Material	FG1A/1124													
Splice Material	3-1/2 Class													
Splice Thickness	0.040													
Bondline Thickness														
Left (in)	3.5	3.0	3.0	3.5	4.0	5.0	3.0	3.5	4.5	5.0	4.0	4.5	4.0	3.5
Right (in)	3.5	4.0	3.5	4.0	4.5	4.5	4.0	3.5	4.5	4.5	4.0	4.5	4.0	3.5
Adhesive Type/Vis	9031/1045													
Batch / Roll	383-103/22													
Layup Time	1600													
Layup Date	1-4-72													
Cure Time	1010													
Cure Rate	1-5-72													
Cure Pressure	30													
Heatup Rate (°F/Min)	3.9													
Cure Temp/Time	250 °F/40 Min													
I.D.N. No.	416605													
Panel Identification														
Composite Material Identification														
Composite Material Identification	381022													
Batch/Roll No.	19/1127													
Layup Time	1600													
Layup Date	1/23/72													
Cure Time	910													
Cure Rate	11/2-72													
Heatup Rate	7.2													
Cure Temp/Time	310°/7 Min.													
I.D.N. No.	42073													

APPENDIX B

TEST DATA FORMS

The results of mechanical properties testing, both static and fatigue, are tabulated in this Appendix for the joints and their constituent materials. These data records provide material properties, specimen configurations, specimen identification, and test conditions and include all material verification and joint test results derived under this program. This information is included in the following order:

<u>Table</u>	<u>Contents</u>
B1	Material Verification and Checkout
B2	Support Fixture Checkout
B3-B16	Bonded Joint Tests - Phase I
IIB--	Bonded Joint Tests - Phase II
IIIB--	Bonded Joint Tests - Phase III
IVB--	Mechanical Joint Tests
VB--	Graphite and Glass Joint Tests
VIB--	Failure Mode Studies

LOCKHEED-GEORGIA COMPANY
 A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

MATERIAL VERIFICATION AND CHECKOUT TESTS - TEST DATA

Specimen No.	V1C01	V1C02	V1C03	V1C01	V1A01	V1A02	V1A03	V1A04	V1A05	V2A01	V2A02	V2A03	V2A04	V2A05
Type of Test	←	→	←	→	←	→	←	→	←	→	←	→	←	→
Temp. Rise	←	→	←	→	←	→	←	→	←	→	←	→	←	→
Temp. Rise	←	→	←	→	←	→	←	→	←	→	←	→	←	→
Drying Test °p	←	→	←	→	←	→	←	→	←	→	←	→	←	→
No. of Flies	←	→	←	→	←	→	←	→	←	→	←	→	←	→
PLY Orient.	←	→	←	→	←	→	←	→	←	→	←	→	←	→
Tab Mat'l	←	→	←	→	←	→	←	→	←	→	←	→	←	→
Specimen Dimensions	←	→	←	→	←	→	←	→	←	→	←	→	←	→
Length - In.	9.10	9.10	5.10	9.08	9.15	9.15	9.12	9.12	9.09	9.10	9.08	9.07	9.10	9.09
Avg. - Width - In.	1.001	1.001	1.001	1.002	1.001	1.001	1.001	.999	1.001	.928	1.000	1.001	1.001	.999
Avg. - Thick - In.	.0419	.0418	.0437	.0432	.0431	.0432	.0434	.0435	.0435	.0429	.0431	.0430	.0432	.0432
Avg. X-Section, Area-In.²	.0435	.0438	.0437	.0433	.0431	.0432	.0434	.0435	.0435	.0424	.0431	.0430	.0432	.0432
Ultimate Load	4480	4560	4650	3820	3560	3940								
Pen. Pounds														
Ult. Stress Psi	102	99.5	107	88.2	81.5	91.0								
E.S.L.														
Mod. of Elast.														
± 10 P.S.I.														
By Strain Gage	15.2	15.5	15.5	14.9	15.0	15.2								
By Extensometer	15.3	15.4	N/A	15.5	14.9	15.2								
Stress Ratio														
Max. Load Pounds														
Max. Stress KSI														
Cycle Rate - CFM														
Potential Life														
Cycles x 10 ⁻³														

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE B1
SERIAL PAGE 2

MATERIAL VERIFICATION AND CHECKOUT TESTS - TEST DATA

Specimen No.	V1B01	V1B02	V1B03	V1B04	V1B05	V1B06	V1B07	V1B08	V1B09	V1B10
Type of Test	←	←	←	←	←	←	←	←	←	←
Test Temp. °F	←	←	←	←	←	←	←	←	←	←
Temp. Rise	27	9	18	N/A	11	0	23	9	11	10
During Test °F	←	←	←	←	←	←	←	←	←	←
No. of Flips	←	←	←	←	←	←	←	←	←	←
Flt. Orient.	←	←	←	←	←	←	←	←	←	←
Tab Mat'l	←	←	←	←	←	←	←	←	←	←
Specimen Dimensions	9.02	9.10	9.12	9.12	9.12	9.10	9.11	9.11	9.10	9.07
Length - In.	9.89	9.90	9.92	9.93	9.94	1.009	1.010	1.013	1.006	1.006
Avg. Width - In.	0.431	0.435	0.432	0.433	0.434	0.434	0.435	0.434	0.438	0.441
Avg. - Thick - In.	0.446	0.441	0.442	0.441	0.441	0.441	0.441	0.441	0.441	0.441
Avg. X-Sect. Area - In. ²	0.446	0.441	0.442	0.441	0.441	0.441	0.441	0.441	0.441	0.441
Ultimate Load	←	←	←	←	←	←	←	←	←	←
Ftu Pounds	←	←	←	←	←	←	←	←	←	←
Ult. Stress Ftu	←	←	←	←	←	←	←	←	←	←
K.S.I.	←	←	←	←	←	←	←	←	←	←
Mod. of Elast.	←	←	←	←	←	←	←	←	←	←
E x 10 ⁶ P.S.I.	←	←	←	←	←	←	←	←	←	←
By Strain Gage	←	←	←	←	←	←	←	←	←	←
By Extensometer	←	←	←	←	←	←	←	←	←	←
Stress Ratio	3410	3445	3215	2585	3020	3505	3280	3080	2645	3085
Max. Load Pounds	80	80	75	60	70	80	75	70	60	70
Max. Stress KSI	480	480	480	480	480	480	480	480	480	480
Cycle Rate - CPM	2.05	.05	.85	132.0	2.91	.21	1.4	3.22	120.0	51
Endurance Life	←	←	←	←	←	←	←	←	←	←
Cycles x 10 ⁻³	←	←	←	←	←	←	←	←	←	←

NOTES: 1. Recorded cycle rates of 120/480 represent a variation in CPM during testing to preclude overheating of the specimen.

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 3

Table R1

MATERIAL VERIFICATION AND CHECKOUT TESTS - TEST DATA

Specimen No.	V3C01	V3C02	V3C03	V3C04	V3C05	V3A01	V3A02	V3A03	V3A04	V3A05	V3A06	V3A07	V3A08	V3A09	V3A10	V3A11	V3A12	V3A13	V3A14	V3A15
Type of Test	Static	Static	Tensile	Adhesive Eval	Adhesive Eval	Titanium 8AL - 1Mo - 1V	Titanium 8AL - 1Mo - 1V	Titanium 8AL - 1Mo - 1V	Titanium 8AL - 1Mo - 1V	SPON EA 9601	SPON EA 9601	SPON EA 9601	SPON EA 9601	SPON EA 9601	SPON EA 9601	SPON EA 9601	SPON EA 9601	SPON EA 9601	SPON EA 9601	SPON EA 9601
Test Temp. °F	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Temp. Rise	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
During Test °F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Adhesive Eval	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Splice Plate Matl.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Adhesive	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Specimen Dimensions	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Length - In.	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Avg. Width - In	.995	.994	.994	.993	.994	.994	.994	.994	.994	.994	.994	.993	.993	.994	.994	.993	.994	.995	.998	.995
Overlap Length - In	.75	.75	.74	.74	.74	.74	.75	.73	.74	.75	.74	.74	.75	.74	.74	.74	.74	.74	.74	.74
Left Side	.74	.74	.75	.75	.75	.74	.74	.75	.73	.74	.75	.74	.75	.74	.74	.74	.74	.74	.74	.74
Right Side	.74	.74	.75	.75	.75	.74	.74	.75	.73	.74	.75	.74	.75	.74	.74	.74	.74	.74	.74	.74
Roundline Thick. In	.0053	.0053	.0050	.0040	.0045	.0045	.0050	.0045	.0045	.0040	.0045	.0045	.0055	.0055	.0050	.0045	.0050	.0050	.0055	.0045
Failure Side	L	P	L	L	R	R	L	L	L	L	L	R	L	R	R	R	L	R	R	R
Failure Area - In ²	.746	.736	.736	.725	.746	.736	.746	.726	.736	.746	.735	.735	.745	.736	.736	.735	.736	.736	.739	.736
Ultimate Load	4220	4140	4300	4150	4200															
Ultimate Shear	5700	5600	5800	5600	5600															
Stress Ratio																				
Max. Load - Pounds																				
Max. Shear																				
Stress - PSI																				
Cycle Rate - UPM																				
Fatigue Life																				
Cycles x 10 ⁻³																				

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

SUPPORT FIXTURE CHECKOUT TESTS - TEST DATA

SPECIMEN NO.	1A111E01	1A111E02	1A111E03	1A111E04	1A111E05	1A111E06
TYPE OF TEST	←	←	←	←	←	←
TEST TEMP °F	←	←	←	←	←	←
TEMP RISE	←	←	←	←	←	←
DURING TEST °F	←	←	←	←	←	←
ADHERED MATL.	9 JULY	BORON/EPoxy	0°/245°			
SPLICE PLATE MATL.	←	6-4 TITANIUM	←	←	←	←
ADHESIVE	←	EPON 9681	←	←	←	←
SPECIMEN DIMENSIONS:						
LENGTH - IN	15.0	15.0	15.0	15.0	15.0	15.0
AVG. WIDTH-IN	.996	.996	.997	.996	.996	.996
OVERLAP LENGTH-IN	.74	.74	.75	.74	.75	.74
LEFT SIDE	.74	.74	.74	.74	.74	.74
RIGHT SIDE	.74	.74	.74	.74	.74	.74
BOND LINE THICK. IN	.0045	.0040	.0050	.0040	.0040	.0040
FAILURE SIDE	←	←	←	←	←	←
FAILURE AREA-IN ²	←	NOMINALLY	0.74	←	←	←
ULTIMATE LOAD	←	←	←	←	←	←
PAU POUNDS	←	←	←	←	←	←
ULTIMATE SHEAR	←	←	←	←	←	←
STRESS PAN-Psi	←	←	←	←	←	←
STRESS RATIO (R)	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
MAX. LOAD-POUNDS	1500	1500	1500	1500	1500	1500
MAX. SHEAR STRESS-Psi	300	300	300	300	300	300
CYCLE RATE - CPM	300	300	300	300	300	300
PATIENCE LIFE	1.31	47.15	4.00	100	4.30	4.0
CYCLES X 10 ⁻³	←	←	←	←	←	←
NOTES:	This specimen was subjected to different dwell rates between 500 and 1500 CPM with 2°F temp rise at 500 CPM, 3°F temp rise at 900 CPM, 5°F temp rise at 1200 CPM and 10°F temp rise at 1500 CPM.					

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DWG. NO. 7226-13021A-1A

SPECIMEN NO. 1A-	111B20	111G11	111C20	111D04	111D05	111D05	111D05	111D01	111D02	111D03	111A01	111A02	111A03	111A04	111A05	111A06	111A07	111A08	111A09	111A10	111A11
DRAWING NO. 7226-13021A	1A100	1A101	1A110	1A103	1A104	1A105	1A106	1A107	1A108	1A109	1A110	1A111	1A112	1A113	1A114	1A115	1A116	1A117	1A118	1A119	1A120
TYPE OF TEST	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE	STATIC TENSILE
R.T. RANGE °	74	75	77	77	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
STG. TEST RISE																					
DURING TEST °																					
ADHERED MAT.																					
SPLICE PLATE MAT.																					
ADHESIVE																					
SPECIMEN DIMENSIONS																					
LENGTH - IN.	1.000	1.003	1.004	1.005	1.001	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002
AVG. WIDTH - IN.																					
OVERLAP LENGTH - IN.																					
LEFT SIDE																					
RIGHT SIDE																					
BONDLINE THICK. IN.																					
FAILURE SIDE																					
FAILURE AREA - IN. ²																					
ULTIMATE LOAD																					
PAU. RATIO																					
ULTIMATE GUTER																					
STRESS PAU - PSI																					
STRESS RATIO (R)																					
MAX. LOAD POUNDS																					
MAX. SING. STRESS-PSI																					
CYCLE RATE - C/M																					
FATIGUE LIFE																					
CYCLES X 10 ⁻³																					
JOINT STIFFNESS																					
(LBS./IN. W/IN) 10 ⁻³																					
NOTES:																					
(1) Splice plate failure occurred on this specimen.																					
(2) Joint stiffness on static specimen determined from slope of load vs. deflection curve for 2.0" gage length.																					

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DWG. NO. 7226-1302IA-1A

SPECIMEN NO. 1A-	111A12	111A13	111A14	111A15	111A16	111A17	111A18	111A21	111A22	111C01	111C02	111C03	111C04	111C05	111C06	111C07	111C08	111C09	111C10	111C21
DRAWING NO. 7226-1302IA	1A82	1A83	1A84	1A85	1A86	1A87	1A88	1A156	1A124	1A69	1A5	1A9	1A13	1A25	1A33	1A41	1A53	1A59	1A63	1A127
TYPE OF TEST																				
R. T. RANGE	10/11	11/12	68/74		10/11	69/71	70/73	73	72/73	-	74	68/75	74/77	69/77	-	-	68/77	74	72	74
SPEC. TEMP. RISE																				
DURING TEST	6	2	4	0	2	5	6	0	4	0	4	5	7	9	-	-	9	4	2	1
ADHEREND MAT.																				
SILAGE PLATE MAT.																				
ADHESIVE																				
SPECIMEN DIMENSIONS																				
LENGTH - IN.																				
AVG. WIDTH - IN.	1.001	1.003	1.000	.998	1.001	1.002	1.000	0.999	0.998	.999	.990	.984	.976	.989	.978	.974	.978	.977	.973	.995
OVERLAP LENGTH - IN.																				
LEFT SIDE	.74	.75	.75	.74	.74	.74	.74	.74	.74	.75	.74	.75	.74	.75	.74	.74	.74	.74	.74	.75
RIGHT SIDE	.75	.75	.75	.75	.76	.76	.75	.75	.75	.75	.74	.74	.75	.75	.75	.74	.73	.75	.74	.74
BONDLINE THICK. IN.	.0046	.0047	.0047	.0047	.0050	.0048	.0041	.0073	.0064	.0051	.0052	.0067	.0056	.0065	.0057	.0068	.0050	.0054	.0054	.0065
FAILURE SIDE	R	L	L	(2)	R	L	R	R	L	(2)	L	(1)	L	(1)	(2)	(2)	R	R	R	R
FAILURE AREA - IN. ²	.751	.722		(2)	.701	.741	.720	.748	.739	(2)	.733	(1)	.722	(1)	(2)	(2)	.713	.732	.724	.736
ULTIMATE LOAD																				
ULTIMATE LOAD			2440																	
ULTIMATE SHEAR																				
STRESS PUL - PSI			1500																	
STRESS RATIO (R)					R = 0 + .10															
MAX. LOAD POINTS	1250	1500	800	1500	1000	1250	1000	1480	910	-2020	-1380	-1160	-1520	-2100	-2100	-1150	-140	-1520	-1950	-2500
MAX. SHEAR STRESS - PSI	1750	2000	1000	2000	1400	1700	1400	2000	1900	-2100	-2700	-1600	-2100	-1600	-2100	-1600	-1600	-2100	-2700	-2400
CYCLE RATE - C/M	1725	120	1500	(2)	1050	1700	1000	1900	1700	900	900	1800	1200	1900	(2)	(2)	1800	1200	200	900
FATIGUE LIFE																				
CYCLES X 10 ⁻³	30	10	(1)	(2)	.715	34	185	4	429	(2)	13.8	24	254	555	(2)	(2)	4390	162.8	40	1.810
JOINT STIFFNESS																				
(LBS/IN/IN WIDTH) 10 ⁻³																				

NOTES:

- (1) No failure, fatigue test discontinued after 10⁷ cycles.
- (2) No test due to machining malfunction.
- (3) 20% max. + 10.0 sec. the maximum joint stiffness are due max. compressive loads but correspond to min. load used in stress ratio relationship.

• Adherend failure, residual strength test.

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DWG. NO. 1226-13021A-1A

SPECIMEN NO. 1A	811A01	811A02	811A03	811A04	811A05	811A06	811A07	811A08	811A09	811A10	811A11	811A12	811A13	811A14
DRAWING NO. 726-13021A	1A71	1A73	1A19	1A26	1A24	1A22	1A39	1A22	1A14	1A18	1A18	1A18	1A18	1A22
TYPE OF TEST	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
R. T. RANGE °	72	73	72	73	73	73	74	73	71-72	73	70	72-73	72	72-73
SPE. TEMP. °	3	2	3	1	-	-	3	-	0	3	2	1	0	0
DURING TEST °	3	2	3	1	-	-	3	-	0	3	2	1	0	0
ADHESIVE MATL.	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
SPACER PLATE MATL.	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
ADHESIVE	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
SPACER DIMENSIONS	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
LENGTH - IN.	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
AVG. WIDTH - IN.	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
OVERLAP LENGTH - IN.	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
LEFT SIDE	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
RIGHT SIDE	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
BOND-LINE THICK. IN.	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
FAILURE SIDE	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
FAILURE AREA - IN.²	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
LOAD	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
PEAK LOAD	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
SHEAR	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
STRESS RATIO (R)	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
MAX. LOAD POUNDS	1030	1050	1030	1020	1030	1020	1030	1020	1700	1860	1790	1720	1750	1750
MAX. SHEAR STRESS - PSI	1600	1600	1600	1600	1600	1600	1600	1600	2300	2500	2400	2300	2400	2300
CYCLE RATE - CM	1650	1650	1650	1650	1650	1650	1650	1650	300	300	300	300	300	300
FATIGUE LIFE	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
STRESS X 10 ⁻³	1031	240	5160	165	5160	965	5160	965	3700	4005	404	5300	760	3760
STRESS STRESS	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
(LBS/IN/IN WIDTH) Q ²	332(1)	335(1)	335(1)	336(1)	336(1)	336(1)	336(1)	336(1)	336(1)	336(1)	336(1)	336(1)	336(1)	336(1)
NOTE:	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
(1) Joint strength on static spec. en determined from slope of 1000 vs. deflection curve for 2.0" gage length.	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -
(2) Specimen failed during static pre-load.	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -	← - - - - -

PHASE I BONDED JOIN TESTS - CONFIGURATION A - DWG. NO. 7720-13021A-1A

[illegible]

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDED JOINT TESTS - CONFIGURATION A - IMG. NO. 7226-13021A-1A

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DATA														
SPECIMEN NO.	IA	511A07	511A08	511A09	511A10	511A11	511A12	511A13	511A14	511A15	511A16	511A17	511A18	511A19
IMG. NO. 7226-13021A	511A07	511A08	511A09	511A10	511A11	511A12	511A13	511A14	511A15	511A16	511A17	511A18	511A19	511A20
TYPE OF TEST	75	73	73	73	70/72	70	70/72	74	68/75	68/69	67/68	69/71	NA	
R.T. RANGE °					1	0	2	0	3	3	7	2	-	
STRESS - TEMP. RISE								8-PLY BORON 0°/45°						
DURING TEST °								104 GALV ANNEALED						
ADHESIVE MATERIAL									EA 9601-06					
SPLICER PLATE MATERIAL														
ADHESIVE														
SPECIMEN DIMENSIONS														
LENGTH - IN.	.694	.699	.699	.699	.696	1.003	1.011	1.009	1.001	.999	.992	.994	1.011	
AVG. WIDTH - IN.	.75	.74	.74	.74	.73	.74	.75	.75	.73	.73	.73	.74	.74	
OVERLAP LENGTH - IN.	.75	.74	.74	.74	.73	.74	.73	.75	.73	.75	.73	.74	.74	
LEFT SIDE	.74	.74	.74	.74	.74	.74	.73	.75	.73	.75	.73	.74	.74	
RIGHT SIDE	.74	.74	.74	.74	.74	.74	.73	.75	.73	.75	.73	.74	.74	
BONDLINE THICK. IN.	.0034	.0034	.0034	.0034	.0034	.0034	.0061	.0053	.0058	.0051	.0055	.0053	.0053	
FAILURE SIDE	R	R	R	R	L	R	L	L	R	L	R	R	R	
FAILURE AREA - IN. 2	.736	.739	.736	.736	.747	.742	.758	.757	.751	.729	.749	.739	.748	
ULTIMATE LOAD	4100	4100	4100	3500			2160	3210						
PSI POUNDS	4100	4100	4100	4800			2900	4300						
ULT. SHEAR STRESS - PSI	4100	4100	4100	4800				40.10						
STRESS RATIO (R)														
MAX. LOAD POUNDS					310	1480	810	1440	750	800	730	665	655	
MAX. SHEAR STRESS - PSI					1100	2000	1100	1900	1000	1100	1000	900	900	
CYCLE RATE - CPM					1800	1625	1800	1700	1550	1575	1550	1625	1625	
FATIGUE LIFE					1790	3	640	5	2000	350	746	1356	1320	
CYCLES X 10 ⁻³														
JOINT STIFFNESS								339						
(1000/LB/IN WIDTH) 10 ⁻³	388	355	376	354										
NOTE: • - Failure occurred in adherend.														

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DNG. NO. 7226-13021A-1A

SPECIMEN NO.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
DNG. NO. 7226-13021A	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
TYPE OF JOINT	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
R.T. BARK OF	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
SPEC. TENS. RISE	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
DURING TEST OF	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
ADHERED MATERIAL	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
SPECIFIC PLATE MATL.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
ADHESIVE	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
SPECIMEN DIMENSIONS	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
LENGTH - IN.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
AUG. WIDTH - IN.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
OVERLAP LENGTH - IN.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
LEFT SIDE	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
RIGHT SIDE	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
ADHESIVE THICK. IN.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
FAILURE SIDE	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
FAILURE AREA - IN. 2	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
FAILURE BLOCK NO.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
FAILURE LOAD NO.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
FAILURE LOAD IN "G"	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
NO. OF CYCLES IN	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
LAST LOAD LEVEL	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
TOTAL NO. OF CYCLES	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
CYCLES X 10 ³	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	
NOTES: * Failure occurred in substrate.	711F01	711F02	711F03	711F04	711F05	711F06	711F07	711F08	711F09	711F10	711F11	

PHASE I ROUNDED JOINT TESTS - CONFIGURATION A - EMC. NO. 7226-13021A-1A

[illegible]

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. 7226-13021A-1B
TABLE 24
PAGE 1

PHASE I BORDER JOINT TESTS - CONFIGURATION A - DWG. NO. 7226-13021A-1B

SPECIMEN NO. LA-7226-13021A	113A01	113A02	113A03	113A04	113A05	113A06	113A07	113A08	113A09	113A10	113A11	113A12	113A13	113A14
DRAWING NO. 13021A	113A01	113A02	113A03	113A04	113A05	113A06	113A07	113A08	113A09	113A10	113A11	113A12	113A13	113A14
TYPE OF TEST	74	74	74	74	74	74	74	74	74	74	74	74	74	74
R.T. RANGE OF	74	74	74	74	74	74	74	74	74	74	74	74	74	74
SPEC. TEMP. RISE	74	74	74	74	74	74	74	74	74	74	74	74	74	74
DURING TEST ° F	74	74	74	74	74	74	74	74	74	74	74	74	74	74
ADHEREND MATL.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
SPALLS PLATE MATL.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
ADHESIVE	74	74	74	74	74	74	74	74	74	74	74	74	74	74
SPECIMEN DIMENSIONS	74	74	74	74	74	74	74	74	74	74	74	74	74	74
LENGTH - IN.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
AVG. WIDTH - IN.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
OVERLAP LENGTH - IN.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
LEFT SIDE	74	74	74	74	74	74	74	74	74	74	74	74	74	74
RIGHT SIDE	74	74	74	74	74	74	74	74	74	74	74	74	74	74
BORDERLINE THICK. IN.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
FAILURE SIDE	74	74	74	74	74	74	74	74	74	74	74	74	74	74
FAILURE AREA - IN.²	74	74	74	74	74	74	74	74	74	74	74	74	74	74
ULTIMATE LOAD	74	74	74	74	74	74	74	74	74	74	74	74	74	74
PER. POINTS	74	74	74	74	74	74	74	74	74	74	74	74	74	74
ULTIMATE STRESS	74	74	74	74	74	74	74	74	74	74	74	74	74	74
STRESS RATIO (1)	74	74	74	74	74	74	74	74	74	74	74	74	74	74
MAX. LOAD RATIO (2)	74	74	74	74	74	74	74	74	74	74	74	74	74	74
MAX. SHEAR STRESS (3)	74	74	74	74	74	74	74	74	74	74	74	74	74	74
UNCL. RATE - GPM	74	74	74	74	74	74	74	74	74	74	74	74	74	74
PERIOD. LIFE	74	74	74	74	74	74	74	74	74	74	74	74	74	74
CYCLES X 10⁻³	74	74	74	74	74	74	74	74	74	74	74	74	74	74
JOINT 5 TYPE	74	74	74	74	74	74	74	74	74	74	74	74	74	74
(1) 1/2 IN. (2) 1/4 IN. (3) 3/8 IN. (4) 1/2 IN.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
NOTES:	74	74	74	74	74	74	74	74	74	74	74	74	74	74
(1) Specimen failed during installation.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
(2) 1/2 fatigue failure, test discontinued after 14 cycles.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
(3) Joint stiffness determined from slope of load vs. deflection curve for 2.0" gage length.	74	74	74	74	74	74	74	74	74	74	74	74	74	74
(4) Splice plate failure.	74	74	74	74	74	74	74	74	74	74	74	74	74	74

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DMO. NO. 7226-13021A-1B AND 1A

SPECIMEN NO.	1A	613001	613002	613003	613004	613005	613006	613007	613008	613009	613010	613011	613012	613013	613014	613015	613016	613017	613018	613019	613020	613021	613022	613023
IDENTIFYING NO. 7226-13021A	1A	613001	613002	613003	613004	613005	613006	613007	613008	613009	613010	613011	613012	613013	613014	613015	613016	613017	613018	613019	613020	613021	613022	613023
TYPES OF TEST	STATIC TENSILE	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
R.T. RANGE °	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74
SPEC. TEST. RATE																								
PLIES TEST °																								
ADHESIVE MATERIAL																								
SPLICER PLATE MATERIAL																								
ADHESIVE																								
SPECIMEN DIMENSIONS																								
LENGTH - IN.																								
AVG. WIDTH - IN.																								
OVERLAP LENGTH - IN.																								
LEFT SIDE																								
RIGHT SIDE																								
BONDING THICK. IN.																								
FAILURE MODE																								
FAILURE AREA - IN. ²																								
ULTIMATE LOAD																								
PEL POUNDS																								
ULTIMATE SHEAR																								
STRESS FAN - PSI																								
STRESS RATIO (R)																								
MAX. LOAD POUNDS																								
MAX. SHEAR STRESS - PSI																								
CYCLE RATE - CPM																								
PATCHING LTR																								
CYCLES x 10 ⁻³																								
JOINT STIFFNESS																								
(LOAD/IN/IN WIDTH) 10 ⁻³																								

LOCKHEED-GEORGIA COMPANY
 A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DMG. NO. 7226-13021A-1C

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DMG. NO. 1228-13021A-10													
SPECIMEN NO., I.A. DRAWING NO. 13021A	112D01	112D02	112D03	112D01	112D02	112D03	112D04	112D05	112D06	112D07	112D08	112D09	112D10
TYPE OF TEST	1003	1007	1011	1001	1002	1004	1005	1006	1008	1009	1010	1012	1013
← STATIC TESTS →	76	76	76	71	71	71	70	71	70/71	72	73	72	70/72
R.T. RANGE °F													
SPEC. TEMP. RISE													
CURIN: TEST °F	0	0	0	0	3	0	4	0	3	2	0	0	3
ADHESIVE FAIL.	←	←	←	←	←	←	←	←	←	←	←	←	←
STITCH: PLATE FAIL.	←	←	←	←	←	←	←	←	←	←	←	←	←
STITCH: DISLOCATION	←	←	←	←	←	←	←	←	←	←	←	←	←
INITIAL - lb.	.997	.995	1.013	.993	.990	.990	.979	.977	.984	.961	1.001	.983	1.002
AVG. WEIGHT - lb.													
OVERALL LENGTH - in.													
LEFT SIDE	.73	.74	.74	.74	.75	.74	.74	.74	.74	.74	.74	.74	.75
RIGHT SIDE	.74	.75	.74	.75	.75	.77	.76	.76	.76	.75	.75	.75	.74
BOUNDARY WICK, in.	.0043	.0044	.0044	.0045	.0045	.0044	.0046	.0046	.0046	.0045	.0043	.0045	.0045
FAILURE SLIP	R	L	L	L	(1)	L	(1)	L	R	(1)	R	L	L
FAILURE AREA - IN. ²	.758	.756	.755	.727	(1)	.755	(1)	.723	.744	(1)	.751	.727	.752
ULTIMATE LOAD													
PEAK FORCES	4340	4150	3910										
ULTIMATE STRESS													
STRESS - psi - P61	5700	5500	5200										
STRESS - psi - P61													
MAX. LOAD FORCE				1240	850	1230	940	1230	750	1000	1350	1240	1040
MAX. SHEAR STRESS - psi				1700	1200	1500	1300	1700	1300	1400	1800	1700	1400
CYCLE RPT. - CM				1700	1800	1700	1500	1675	1750	1800	1800	1800	1650
FATIGUE LIFE													
CYCLES X 10 ⁻³				3	109	9	110	18	30	151	2	18	55
JOINT STRESS													
(1) STRESS/IN. WICK (H)	134 (2)	133 (2)	130 (2)										
NOTES:													
(1) A splice plate failure occurred on this specimen.													
(2) Joint stress at static specimens determined from slope of load vs. deflection curve for 2.0" gage length.													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 1

PHASE I BONDTM JOINT TESTS - CONFIGURATION A - DWG. NO. 7226-13221A-5B

SPECIMEN NO. 1A	213D01	213D02	213D03	213A01	213A02	213A03	213A04	213A05	213A06	213A07	213A08	213A09	213A10
DRAWING NO. 13221A	5903	5907	5911	5901	5902	5904	5905	5906	5908	5909	5910	5912	5913
TYPE OF TEST	←- STATIC TENSILE	73	73	73/75	72/75	69	70/71	69/71	69	67/69	70	70/71	69
R.T. RANGE °	71	73	73	73/75	72/75	69	70/71	69/71	69	67/69	70	70/71	69
SPEC. TEMP. RISE	0	0	0	2	4	0	1	3	0	2	2	4	0
DURING TEST °	←	←	←	←	←	←	←	←	←	←	←	←	←
ADHEREND MATL.	←	←	←	←	←	←	←	←	←	←	←	←	←
SPLICE PLATE MATL.	←	←	←	←	←	←	←	←	←	←	←	←	←
ADHESIVE	←	←	←	←	←	←	←	←	←	←	←	←	←
SPECIMEN DIMENSIONS	←	←	←	←	←	←	←	←	←	←	←	←	←
LENGTH - IN.	1.003	.999	1.007	1.009	1.004	1.006	1.002	1.003	1.004	1.000	1.007	1.012	1.000
AVG. WIDTH - IN.	.76	.75	.75	.76	.76	.76	.76	.76	.76	.75	.76	.76	.76
OVERLAP LENGTH - IN.	.74	.74	.74	.74	.74	.74	.74	.74	.74	.75	.75	.75	.74
LEFT SIDE	.0057	.0057	.0052	.0057	.0057	.0057	.0055	.0057	.0050	.0057	.0060	.0050	.0050
RIGHT SIDE	P	L	L	R	R	R	R	R	L	R	R	R	L
BONDLINE THICK. IN.	.742	.749	.765	.747	.743	.744	.751	.742	.763	.750	.755	.759	.760
FAILURE AREA - IN. ²	2700	2560	2370										
ULTIMATE LOAD	3600	3400	3100										
STRESS FAU - PSI													
STRESS RATIO (R)													
MAX. LOAD POUNDS				955	1040	1190	1200	965	1200	975	1210	985	1180
MAX. SHEAR STRESS-PSI				1300	1400	1600	1600	1300	1600	1300	1600	1300	1600
CYCLE RATE - GPM				1800	1800	1675	1800	1500	1800	1700	1800	1800	1650
FATIGUE LIFE				438	170	17	36	2550	18	172	25	120	8
CYCLES X 10 ⁻³													
JOINT STIFFNESS													
(LBS/IN/IN WIDTH)10 ⁻³	331(1)	330(1)	317(1)										
NOTES:													
(1) Joint stiffness on static specimens determined from slope of load vs. deflection curve for 2.0" gage length.													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE _____

PHASE 1 BONDED JOINT TESTS - CONFIGURATION A - WG. NO. 7226-13021A-5A

SPECIMEN NO.	1A	211D01	211D02	211D03	211D04	211D05	211D06	211A11	211A12	211A13	211A14	211A15	211A16	211A17	211A18	211A19	211A20
WGT. LBS.	7226-13021A	5A03	5A07	5A11	5A17	5A21	5A25	5A15	5A16	5A18	5A19	5A20	5A22	5A24	5A26	5A27	5A28
TYPE OF TEST	STATIC TENSILE	76	77	75	71	77	76	70/75	70/71	69/69	FATIGUE	70/71	70/71	69/70	68	70/71	72
R.T. NAME OF																	
REG. TEMP. RISE								6	1	3	0	3	2	2	0	3	0
BURING TEST F								8-PLY BOND 45°/0°									
ADHESIVE MATERIAL								TITANIUM 5A1 - HV ANNEALED									
STRESS STATE MAT.								EPON 826 501 - .06									
ADHESIVE																	
STRESSOR DIMENSION																	
LENGTH - IN.								NOMINALLY 18.0									
AVG. WIDTH - IN.								1.000	1.000	1.005	1.002	1.013	1.011	1.009	.992	1.004	1.005
OVERLAP LENGTH - IN.																	
LEFT SIDE								.75	.71	.74	.74	.75	.71	.71	.71	.76	.76
RIGHT SIDE								.75	.71	.74	.74	.75	.71	.71	.71	.76	.76
LOADING RATE - IN.								.005	.005	.005	.005	.005	.005	.005	.005	.005	.005
FAILURE SIGN								L	L	L	R	R	R	R	R	R	R
FAILURE AREA - IN. ²								.750	.750	.744	.741	.750	.748	.747	.739	.743	.744
ULTIMATE LOAD																	
POUNDS								2170	1360								
ULTIMATE WEAR																	
STRESS FAT-PAL								1000	2000								
STRESS RATIO (R)																	
MAX. LOAD POUNDS								1120	1500	1260	1430	1200	1500	1200	1430	1190	1470
MAX. SHEAR STRESS-PSI								1500	2000	1700	2000	1600	2000	1600	2000	1600	2000
CYCLE RATE - CPL								1572	1800	1800	1750	1800	1772	1800	1750	1750	1750
FATIGUE LIFE																	
CYCLES x 10 ⁻³								4200	5	85	7	365	11	76	4	122	2
JOINT STRENGTH (LBS/IN WIDTH) ¹⁰⁻³																	
UIJC																	
NOTES: * - Failure occurred in Adherent.																	

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 1

PHASE I BONDED JOINT TESTS - CONFIGURATION A - Dwg. NO. 7226-13021A-9B & 9C

SPECIMEN NO. 1A	313D01	313D02	313D03	313A01	313A02	313A03	313A04	313A05	313A06	313A07	312D01	312D02	312D03	312A01	312A02	312A03	312A04	312A05
DRAWING NO. 7226-13021A	9806	9806	9806	9801	9803	9804	9805	9807	9808	9810	9802	9804	9807	9801	9803	9805	9806	9808
TYPE OF TEST	75	75	76	71/72	69	71	72	71/72	69/71	(2)	75	75	75	61/74	72/74	71/73	71/75	71/74
R ² , RANGE OF																		
SPEC. TEMP. RISE DURING TEST °F	0	0	0	0	0	0	0	1	3	(2)	0	0	0	1	0	1	2	2
ADHEREND MATL.										B-PLI, BORON O ⁹ /45°								
SPLICE PLATE MATL.																		
ADHESIVE										EPON 8A 9601-06								
SPECIMEN DIMENSIONS																		
LENGTH - IN.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AVG. WIDTH - IN.																		
OVERLAP LENGTH - IN.																		
LEFT SIDE	.50	.51	.50	.51	.51	.50	.51	.51	.50	.50	.49	.49	.49	.49	.49	.50	.49	.51
RIGHT SIDE	.50	.50	.50	.50	.49	.49	.49	.49	.50	.49	.49	.49	.50	.49	.50	.49	.50	.49
BONDLINE THICK. IN.	.0051	.0053	.0050	.0047	.0050	.0051	.0051	.0047	.0056	.0053	.0046	.0045	.0046	.0045	.0044	.0045	.0041	.0048
FAILURE SIDE	R	L	L	L	L	L	R	L	R	R	R	L	R	L	L	L	L	L
FAILURE AREA - IN. ²	.501	.514	.494	.514	.512	.502	.493	.514	.499	.491	.479	.482	.490	.480	.483	.481	.481	.481
ULTIMATE LOAD																		
PPH POUNDS	2230	2620	2420								3090	3020	2650					
ULTIMATE SHEAR																		
STRESS IN - PSI	5000	5200	5000								6500	6300	5400					
STRESS RATIO (R)																		
MAX. LOAD POUNDS				910	790	630	690	690	680	690				670	680	580	670	680
MAX. WEAR STRESS - PSI				1800	1500	1100	1400	1300	1400	1400				1300	1400	1400	1400	1400
CYCLE RATE - J/M				162	1475	1600	1475	1600	1600	1450				1700	1400	1600	1700	1600
FATIGUE LIFE																		
CYCLES X 10 ⁻³																		
JOINT EFFICIENCY				2	5	108	565	48	828	73								
(LBS/IN/IN MID THICK) 1/27(3)	27(3)	27(3)	253(3)								246(3)	262(3)	251(3)					

NOTES:

- (1) A splice plate failure occurred on this specimen.
- (2) No temperature record.
- (3) Joint efficiency determined from slope of load vs. deflection curve for 2.0" gage length.

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 37-2

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DWG. NO. 7226-13021A-9A

SPECIMEN NO.	1A	11A01	11A02	11A03	11A04	11A05	11A06	11A07	11A08	11A09	11A10	11A11	11A12	11A13	11A14	11A15
DWG. NO.	7226-13021A	9A01	9A02	9A03	9A04	9A05	9A06	9A07	9A08	9A09	9A10	9A11	9A12	9A13	9A14	9A15
TYPE OF TEST	STATIC TENSILE	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
TEST RANGE	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
SPEC. TEMP. DISC.																
BURLING TEST																
ADHESIVE MATERIAL																
SPALLS PLATE MATERIAL																
ADHESIVE																
SPECIMEN DIMENSIONS																
LENGTH - IN.	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002
AVG. WIDTH - IN.	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002
OVERLAP LENGTH - IN.	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002
LEFT SIDE																
RIGHT SIDE																
NOMINAL THICK. IN.	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002
FAILURE MODE																
FAILURE AREA - IN. ²	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002	1.002
ULTIMATE LOAD	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172
PER POUNDS	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172	2172
ULTIMATE SHEAR																
STRESS PER - PSI	4100	4100	4100	4100	4100	4100	4100	4100	4100	4100	4100	4100	4100	4100	4100	4100
STRESS RATIO (1)																
MAX. LOAD POUNDS																
MAX. SHEAR STRESS - PSI																
CYCLE RATE - CPM																
FATIGUE LIFE																
STRESS X 10 ⁻³																
JOINT STIFFNESS																
(LBS./IN. WIDTH) 10 ⁻³	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278	278
NOTES:	Failure occurred in Adhesive.															

PHASE I BONDED JOINT TESTS - CONFIGURATION A - Dwg. NO. 7226-13021A-11A

SPECIMEN NO.	JA	911001	911002	911003	911004	911005	911006	911007	911008	911009	911010	911011	911012
DWg. NO. 7226-13021A	11A04	11A10	11A17	11A23	11A30	11A31	11A32	11A33	11A34	11A35	11A36	11A37	11A38
TYPE OF TEST	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
R.T. BOND	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
STRENGTH RISE	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
DELTA T ₉₀	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
ADHESIVE MATERIAL	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
SPALL PLATE MATERIAL	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
ADHESIVE	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
SPECIMEN DIMENSIONS	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
LEFT SIDE	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
RIGHT SIDE	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
80° LINE TEST IN	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
FAILURE SIDE	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
FAILURE AREA - IN ²	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
ULTIMATE LOAD	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
PEL FOLDING	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
ULTIMATE SHEAR	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
STRESS PER - PSI	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
STRESS RATIO (R)	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
MAX. LOAD POUNDS	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
MAX. SHEAR STRESS - PSI	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
CYCLE RATE - CPH	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
PATIENCE RATE	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
CYCLES x 10 ⁻³	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
JOINT STIFFNESS	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
(LBS/IN/IN MIN)	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71
NOTES: * - Failure occurred in adhesive.	76	76	76	76	76	77	69/72	71	71	69/71	70/71	70	70/71

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDED JOINT TESTS - CONFIGURATION A - DWG. NO. 7226-13021A-11A

ITEM OF TEST	911007	911008	911009	911010	911011	911012	911013	911014	911015	911016	911017	911018	911019	911020	911021	911022	911023	911024	911025	911026	911027	911028	911029	911030	911031	911032	911033
1. SPEC. TEMP. RISE	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
2. DURING TEST OF	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
3. AFTERED MATERIAL																											
4. REFERENCE PLATE MATERIAL																											
5. ADHESIVE																											
6. JOINTEN DIRECTION																											
7. LEAD IN - IN.	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
8. JOINTEN LENGTH - IN.	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
9. LEFT SIDE	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
10. RIGHT SIDE	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
11. BONDLINE THICK. IN.	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
12. FAILURE SIDE	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
13. FAILURE AREA - IN. ²	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
14. JOINTEN LOAD	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
15. PER POUNDS	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
16. ULTIMATE SHEAR	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
17. STRESS PER. = PAL	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
18. STRESS RATIO (R)	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
19. MAX. JOINT FORTN	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
20. MAX. SHEAR STRESS-PAL	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
21. CYCLE RATE - CPM	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
22. FATIGUE LIFE	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
23. CYCLES x 10 ⁻³	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
24. JOINT STIFFNESS	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
25. (LBS/IN/IN WIDTH) 10 ⁻³	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927	927
NOTES: ULDC - Unusable Load - Deformation Curve																											
• Adhesive Failure																											

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDING JOINT TESTS - COMPLICATION A - DWJ, NO. 722A-13A

13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13
13A01	13A02	13A03	13A01	13A02	13A03	13A04	13A05	13A06	13A07	13A08	13A09	13A10	13A11	13A12	13A13

PHASE I BONDED JOINT TEST - CONFIGURATION A - Dwg. NO. 7226-13021A-15A

SPECIMEN NO.	1A	421D01	421D02	421D03	421D04	421D05	421D06	421A11	421A12	421A13	421A14	421A15	421A16	421A17	421A18	421A19	421A20
DWG. NO. 7226-13021A	15A03	15A07	15A11	15A16	15A21	15A26	15A31	15A36	15A41	15A46	15A51	15A56	15A61	15A66	15A71	15A76	15A81
TYPE OF TEST	STATIC TENSILE - THICKNESS EFFECTS	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77
R.T. RANGE °F	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72
SPRINT. TEMP. RISE DURING TEST °F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ADHEREND MATERIAL	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90	16-5% BORO 69/90
SPRACE PLATE MATL.	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED
ADHESIVE	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100	EPON 826-100
SPECIMEN DIMENSIONS																	
LENGTH - IN.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
AVG. WIDTH - IN.	.969	.969	.969	.969	.969	.969	.969	.969	.969	.969	.969	.969	.969	.969	.969	.969	.969
OVERLAP LENGTH - IN.	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
LEFT SIDE	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
RIGHT SIDE	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
BONDLINE THICK. IN.	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033	.0033
FAILURE SIDE	L*	L*	L*	L*	L*	L*	L*	L*	L*	L*	L*	L*	L*	L*	L*	L*	L*
FAILURE AREA - IN. 2	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030	2030
ULTIMATE LOAD	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590
ULTIMATE SHEAR	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590
STRESS PER IN. 2	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590
STRESS RATIO (R)	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033	0.0033
MAX. LOAD POUNDS	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590
MAX. SHEAR POUNDS	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590	2590
CYCLE RATE - CPM	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725	1725
FATIGUE LIFE	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
CYCLES x 10 ⁻³	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315	315
JOINT STIFFNESS	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395
(LBS/IN/IN WIDTH) 10 ⁻³	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395	395

NOTES: * - Failure occurred in adherend.
** - Specimens not tested, adherend material unacceptable.

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE D-10
MODEL B10-2
PAGE

PHASE I BONDED JOINT CONFIGURATION B - DMS. NO. 7226-1307H-1A

SECTION NO. IN	111C01	111C02	111C03	111C04	111C05	111C06	111C07	111C08	111C09	111C10	111C11	
DEWING NO. 7226-1307H	1A01	1A02	1A03	1A13	1A15	1A19	1A20	1A25	1A27	1A32	1A05	
TYPE OF JOINT												
R.T. RANGE °	75/77	75/77	75/77	75/77	75/77	75/77	75/77	75/77	75/77	75/77	75/77	
JOINT TEST. RICH												
BONDING TEST °	4	4	4	4	4	4	4	4	4	4	4	
ADHEREND MATERIAL 1												
2. BONDED MATERIAL												
ADHESIVE												
MECHANICAL DIMENSIONS												
WIDTH - IN.	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	
HEIGHT - IN.	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	
STICKER LENGTH - IN.	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	
B. BOND THICK. - IN.												
TEST 1	.0052	.0053	.0055	.0040	.0045	.0039	.0047	.0040	.0047	.0043	.0044	
TEST 2	.0051	.0045	.0040	.0030	.0043	.0032	.0044	.0037	.0040	.0036	.0043	
TEST 3	.0045	.0045	.0045	.0040	.0040	.0042	.0037	.0040	.0037	.0040	.0038	
FAILURE AREA - IN.	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	
ULTIMATE LOAD												
PER POUND												
ULTIMATE JERK												
STRESS PER - PSI												
STRESS RATIO (H)												
MAX. LOAD FOUND	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	
MAX. JERK FOUND	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	
CYCLE RATE - CPM	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	
FATIGUE LIFE												
CYCLES 10^{-3}	104.5	103.4	29.1	65.3	105	5.8	201.8	11.6	37.5	205.5		
JOINT STIFFNESS												
(LBS/IN/IN WITH) 10^{-3}												

NOTE: ① - THIS SPECIMEN WAS USED FOR CONDUCTING A TEMPERATURE SURVEY AND WAS NOT TESTED TO FAILURE.

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE 3

PHASE I BONDED JOINTS CONFIGURATION B - DNG. NO. 7226-1302IB-1A

SPRINTING NO.	511A01	511A02	511A03	511A04	511A05	511A06	511A07	511A08	511A09	511A10
DRAWING NO. 7226-1302IB-1A-1	511A01	511A02	511A03	511A04	511A05	511A06	511A07	511A08	511A09	511A10
TYPE OF TEST	77	77	77	77	77	77	77	77	77	77
R.T. RANGE °F	77	77	77	77	77	77	77	77	77	77
SPEC. TEMP. RISE										
DWELLING TEST °F										
ADHESIVE MATERIAL (1)										
ADHESIVE MATERIAL (2)										
ADHESIVE										
SPECIFIC DIMENSIONS										
LENGTH - IN.	1.002	1.000	1.003	1.002	1.001	1.000	1.001	1.002	1.000	1.000
AVG. WIDTH - IN.	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47
OVERLAP LENGTH - IN.										
BONDLINE THICK. - IN.										
STEP 1	(NOT RECORDED)									
STEP 2										
STEP 3										
FAILURE AREA - IN. ²										
ULTIMATE LOAD	5840	5510	6100	5700	6070	5300	5520	5740	5510	5820
PEAK LOAD - PSI	4000	3400	4100	4900	4100	3600	4100	3900	4100	4000
STRESS RATIO (R)										
MAX. LOAD - POUNDS										
MAX. SHEAR STRESS - PSI										
CYCLE RATE - CFM										
FATIGUE LIFE										
CYCLES x 10 ⁻³										
JOINT STIFFNESS										
(LBS/IN/IN WIDTH) 10 ⁻³	574	527	570	572	570	576	590	610	561	563
*B - FAILURE OCCURRED IN BOND ADHESIVE										

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE B10
MODEL B10-1
PAGE

PHASE I BONDED JOINTS CONFIGURATION B - ENG. NO. 7226-1302IB-1B

SPECIMEN NO. 1B	112D01	112D02	112D03	112A01	112A02	112A03	112A04	112A05	112A06	112A07	112A08	112A09	112A10
DRAWING NO. 7226-1302IB-1B04	1808	1808	1813	1802	1803	1805	1806	1807	1810	1811	1812	1814	1815
TYPE OF TEST	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	70/72	72/75	68	71/74	70/72	72/73	72	70/75	73	73/75
R.T. RANGE °	69	69	69	1	3	1	10	3	5	2	4	4	4
SPEC. TEMP. RISE													
DURING TEST °													
ADHEREND MATERIAL 1							16-PLY BORON 07450						
ADHEREND MATERIAL 2							ALUMINUM 7075-T6						
ADHESIVE							EPOXY 849601-045						
SPECIMEN DIMENSIONS													
LENGTH - IN.							NOMINALLY 18.0						
AVG. WIDTH - IN.	.926	.922	.927	.996	.997	.993	.994	.994	.995	.996	.996	.996	.994
OVERLAP LENGTH - IN.	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.48	1.47	1.48	1.47	1.47	1.47
BONDLINE THICK - IN.													
STEP 1	.0034	.0034	.0035	.0035	.0036	.0034	.0036	.0032	.0036	.0037	.0035	.0030	.0034
STEP 2	.0035	.0035	.0032	.0040	.0037	.0035	.0036	.0075	.0029	.0040	.0039	.0036	.0035
STEP 3	.0035	.0040	.0036	.0040	.0040	.0036	.0034	.0033	.0040	.0040	.0040	.0034	.0037
FAILURE AREA - IN. ²	*A	*A	*A	*A	*A	*A	*A	*A	*A	*A	*A	*A	*A
ULTIMATE LOAD	4830	4870	4830										
Pen POUNDS													
ULTIMATE SHEAR													
STRESS Pen - Psi	3300	3300	3100										
STRESS RATIO (R)													
MAX. LOAD POUNDS				1910	1330	1920	1320	1910	1310	1910	1310	1900	1310
MAX. SHEAR STRESS-Psi				1300	900	1300	900	1300	900	1300	900	1300	900
CYCLE RATE - CPM				1625	1600	1700	1750	1575	1800	1675	1800	1550	1600
FATIGUE LIFE													
CYCLES X10 ⁻³				20	470	20	2390	22	330	16	1320	25	539
JOINT STIFFNESS													
(LBS./IN/IN WIDTH)X10 ⁻³	495	432	460										
NOTE:	*A - FAILURE OCCURRED IN ALUMINUM ADHEREND.												

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
MODEL _____
PAGE _____

TABLE B11

B11-1

PHASE I BOLTED JOINTS CONFIGURATION B - DWG. NO. 7226-1302B-3A

SPECIMEN NO. ID	121D01	121D02	121D03	121A01	121A02	121A03	121A04	121A05	121A06	121A07	121A08	121A09	121A10
DRAWING NO. 7226-1302B	3A04	3A08	3A13	3A02	3A03	3A05	3A06	3A07	3A10	3A11	3A12	3A14	3A15
TYPE OF TEST	← STATIC TENSILE →												
I.T. RANGE °F	73	73	73	73/74	66/68	74/75	69	64/70	72	70/75	72	72/75	70
SPEC. TEMP. RISE													
DURING TEST °F				5	1	4	6	5	4	3	6	0	0
ADHESIVE MATERIAL 1							16-PLY BORON 4/90°						
ADHESIVE MATERIAL 2							TITANIUM GALV ANNEAL						
ADHESIVE							EPON 84 9601-045						
SPECIMEN DIMENSIONS													
LENGTH - IN.													
AVG. WIDTH - IN.	1.000	1.701	1.001	1.060	1.001	1.000	1.000	1.001	1.002	1.001	1.002	1.002	1.002
OVERLAP LENGTH - IN.	1.147	1.148	1.147	1.143	1.145	1.146	1.147	1.147	1.147	1.146	1.146	1.145	1.146
BONDLINE THICK. - IN.													
STEP 1	.0044	.0042	.0038	.0042	.0040	.0040	.0040	.0040	.0044	.0040	.0040	.0040	.0044
STEP 2	.0037	.0036	.0037	.0037	.0035	.0036	.0035	.0036	.0039	.0037	.0036	.0039	.0038
STEP 3	.0036	.0037	.0036	.0036	.0035	.0036	.0037	.0035	.0036	.0035	.0037	.0036	.0036
FAILURE AREA - IN. ²	*B	*B	*B	1.143	1.145	1.146	1.147	1.147	*B	1.146	*B	1.145	*B
ULTIMATE LOAD													
PSI POUNDS	4560	5660	4820										
ULTIMATE JEAR													
STRESS Fsu - Psi	3100	3600	3300										
STRESS RATIO (R)													
MAX. LOAD POUNDS				2000	2610	1900	2650	2360	2650	1900	2630	1880	2630
MAX. SHEAR STRESS-PSI				1400	1800	1300	1800	1400	1800	1300	1800	1300	1800
CYCLE RATE - CFM				1800	1725	1750	1800	1775	1800	1775	1750	1775	1800
FATIGUE LIFE													
CYCLES X10 ³				223	30	803	68	220	21	535	25	783	13
JOINT STIFFNESS													
(LBS/IN/IN WIDTH)10 ⁻³	600	554	585										
*B - FAILURE OCCURRED IN BORON ADHESIVE													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE B12
MODEL B12-1
PAGE

PHASE I BONDED JOINTS CONFIGURATION B - DMG. NO. 7226-1302IB-5A

SPECIMEN NO. ID	211D01	211D02	211D03	211A01	211A02	211A03	211A04	211A05	211A06	211A07	211A08	211A09	211A10
DRAWING NO. 7226-1302IB	5A04	5A09	5A13	5A02	5A03	5A05	5A06	5A07	5A10	5A11	5A12	5A14	5A15
TYPE OF TEST	68	68	68	72/73	70/76	73	73/75	72/73	74/75	73/74	74/76	73	74/76
R.T. RANGE °F	68	68	68	72/73	70/76	73	73/75	72/73	74/75	73/74	74/76	73	74/76
SPEC. TEMP. RISE													
DURING TEST °F				4	8	0	4	0	0	7	0	6	3
ADHEREND MATERIAL 1							16-PLY BORON 0/245°						
ADHEREND MATERIAL 2							TITANIUM 6AL-4V ANNEALED						
ADHESIVE							EPON 81501-1045						
SPECIMEN DIMENSIONS													
LENGTH - IN.							NOMINALLY 18.0						
AVG. WIDTH - IN.	1.000	1.002	1.002	1.003	1.000	1.000	.998	1.001	1.000	1.000	1.001	1.001	1.001
OVERLAP LENGTH - IN.	1.45	1.48	1.46	1.46	1.45	1.46	1.46	1.46	1.47	1.47	1.47	1.47	1.49
BONDLINE THICK. - IN.													
STEP 1	.0035	.0036	.0038	.0037	.0037	.0037	.0038	.0036	.0036	.0035	.0035	.0035	.0035
STEP 2	.0036	.0036	.0036	.0038	.0038	.0037	.0040	.0035	.0035	.0036	.0037	.0036	.0038
STEP 3	.0045	.0038	.0040	.0046	.0044	.0044	.0046	.0028	.0042	.0042	.0045	.0040	.0045
FAILURE AREA - IN. ²	*B	*B	*B	1.46	1.45	1.46	1.46	1.46	1.47	1.47	1.47	1.47	1.49
ULTIMATE LOAD													
PULL FORCES	5960	5720	5860										
ULTIMATE SHEAR													
STRESS P_{avg} - PSI	4100	3900	4000										
STRESS RATIO (R)				2040	1600	2190	1900	2190	1760	2200	1760	2200	1790
MAX. LOAD POUNDS				1400	1100	1300	1300	1500	1200	1500	1200	1500	1200
MAX. SHEAR STRESS-PSI				1800	1725	1800	1800	1800	1775	1775	1800	1775	1750
CYCLE RATE - CPN													
FATIGUE LIFE				51	4438	12	97	15	1770	40	770	41	275
CYCLES 10^{-3}													
JOINT STIFFNESS													
LBS/IN/IN WIDTH 10^{-3}	562	576	550										
*B - FAILURE OCCURRED IN BORON ADHEREND.													

PHASE I BONDED JOINTS CONFIGURATION B - DMC. NO. 7226-1302IB-9A

SPECIMEN NO. IB	311D01	311D02	311D03	311A01	311A02	311A03	311A04	311A05	311A06	311A07	311A08	311A09	311A10
DRAWING NO. 7226-1302IB	9A03	9A08	9A13	9A01	9A02	9A04	9A06	9A07	9A09	9A10	9A12	9A14	9A15
TYPE OF TEST	STATIC TENSILE				FATIGUE	LAP LENGTH EFFECTS							
R.T. RANGE °F	72	74	76	63/72	58/74	70/72	72/75	68/69	72/77	70/73	64/75	69/72	73/74
SPEC. TEMP. RISE				2	2	2	5	3	2	3	3	6	0
DURING TEST OF							16-PLY BORON 0°/45°						
ADHEREND MATERIAL 1							TITANIUM 6AL-4V ANNEALED						
ADHEREND MATERIAL 2							EPON 84-9601-045						
ADHESIVE													
SPECIMEN DIMENSIONS							NOMINALLY 18.0						
LENGTH - IN.													
AVG. WIDTH - IN.	.999	1.000	1.001	1.000	1.001	1.000	.999	1.001	1.000	1.001	1.003	1.002	1.001
OVERLAP LENGTH - IN.	1.10	1.13	1.14	1.10	1.10	1.10	1.11	1.12	1.13	1.13	1.14	1.14	1.14
BONDLINE THICK. - MIL.													
STEP 1	.0043	.0043	.0045	.0046	.0041	.0045	.0043	.0035	.0047	.0036	.0036	.0036	.0045
STEP 2	.0033	.0040	.0042	.0037	.0040	.0045	.0038	.0042	.0042	.0035	.0042	.0042	.0040
STEP 3	.0042	.0044	.0040	.0042	.0040	.0047	.0042	.0047	.0035	.0037	.0042	.0045	.0039
FAILURE AREA - IN.²	1.10	1.10	1.14	1.10	1.10	1.10	1.11	1.12	1.13	1.13	1.14	1.14	1.14
ULTIMATE LOAD													
Pau POUNDS	2920	5110	5340	4920	3800								
ULTIMATE SHEAR													
STRESS Pau - Psi	2700	4500	4700	4500	3500								
STRESS RATIO (R)						R = 4.10							
MAX. LOAD POUNDS				550	990	990	1220	1790	1240	1810	1250	1820	1820
MAX. SHEAR STRESS-PSI				570	950	900	1100	1600	1100	1600	1100	1600	1600
CYC/2 RATE - CPM				1450	1600	1700	1775	1650	1800	1700	1800	1800	1800
FATIGUE LIFE				10300	11800								
CYCLES X10⁻³				(1)	(1)	22	324	26	5878	428	3420	155	25
JOINT STIFFNESS													
(LBS/IN/IN WIDTH)10⁻³	623	585	608	634	576								
*B - Failure occurred in bond adhesive.													
(1) - No fatigue failure, test discontinued and specimens tested for residual strength.													

LOCKHEED-GEORGIA COMPANY
 A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I BONDED JOINT TESTS - CONFIGURATION C - DMO. NO. 7226-1302IC-1A

SPECIMEN NO. IC	111A01	111A02	111A03	111A04	111A05	111A06	111A07	111A08	111A09	111A10	111D01	111D02	111D03
DMO. NO. 7226-1302IC	1A02	1A03	1A05	1A06	1A07	1A09	1A10	1A11	1A13	1A14	1A04	1A08	1A10
TYPE OF TEST	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
RAT. BASIS	0	0	0	0	0	0	0	0	0	0	0	0	0
APPL. TEMP. - °F	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
ADHESIVE MATL.	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
7" MATERIAL	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
ADHESIVE	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
SPECIMEN DIMENSIONS	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
LENGTH - IN.	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
AVG. WIDTH - IN.	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
7" BONDED LENGTH - IN.	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
BONDED AREA - IN. ²	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
AVG. BONDLINE STICK TH.	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
STATIC AXIAL	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
LOAD - POUNDS	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
ULTIMATE SIDE	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
LOAD - POUNDS	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
STRESS RATIO (R)	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
MAXIMUM DYNAMIC	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
AXIAL LOAD - POUNDS	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
APPLIED SIDE LOAD-LBS	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
DYNAMIC SIDE LOAD	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
MAXIMUM POUNDS	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
MINIMUM	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
CYCLE RATE - CPM	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
FATIGUE LIFE	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71
CYCLES x 10 ⁻³	75	73	70/72	72/74	72	74/75	75	72/74	74	72	73	71	71

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE B15
MODEL. B15-1
PAGE

PHASE I BONDED JOINT TESTS - CONFIGURATION D - DMO. NO. 7226-1302ID-1A

SPECIMEN NO. ID	111D02	111D03	111A01	111A02	111A03	111A04	111A05	111A06	111A07	111A08	111A09	111A10	111A11
DMO. NO. 7226-1302ID	1A03	1A08	1A01	1A02	1A05	1A06	1A07	1A08	1A10	1A11	1A14	1A15	1A04
TYPE OF TEST	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC
R.S. NAME	77	76	69	67/77	71/72	68/70	68/70	68/70	68/70	70/71	72	70/71	69/70
SPEC. TEMP RISE	77	76	69	67/77	71/72	68/70	68/70	68/70	68/70	70/71	72	70/71	69/70
DURING TEST	77	76	69	67/77	71/72	68/70	68/70	68/70	68/70	70/71	72	70/71	69/70
ADHERED MATL.	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07	8 PLY BAKON 07
SPLICE PLATE MATL.	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED	TITANIUM 6AL-4V ANNEALED
ADHESIVE	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84	EPON 84
SPECIMEN DIMENSIONS													
LENGTH - IN.	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
AVG. WIDTH - IN.	.990	.991	.991	.991	.991	.991	.991	.991	.991	.991	.991	.991	.991
WING TIP LENGTH - IN.													
LEFT SIDE	77/75	76/74	76/74	77/75	76/74	76/74	76/74	76/74	76/74	76/74	76/74	76/74	76/74
RIGHT SIDE	77/75	76/74	76/74	77/75	76/74	76/74	76/74	76/74	76/74	76/74	76/74	76/74	76/74
BONDLINE THICK. IN.	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5	5.0/6.5
FAILURE SIDE	1	1	1	1	1	1	1	1	1	1	1	1	1
FAILURE AREA - IN. 2	1.53	1.49	1.50	1.51	1.49	1.49	1.49	1.52	1.49	1.49	1.49	1.49	1.50
DISPATCH. LOAD													
PER. POINTS	3150	3200	3025										
DISPATCH. REMARK													
STRESS P.S. - Psi	3500	3500	3400										
STRESS (ATTO. IN)													
MAX. LOAD (OUNDS													
MAX. UNB. STRESS (TSI													
SPICE RATE - CTH													
FAILURE LPT.													
CYCLES 10 ³													
JOINT STIFFNESS													
DIS/IN/IN VIB/IN	763	771	761										
WHERE BONDLINE FAILURE DID NOT OCCUR THE AVERAGE FAIRING OF THE RIGHT AND LEFT BONDLINE ARE GIVEN.													
FAILURE OCCURRED IN ADHERED													
NOT FAILED													
FAILED (IN LOADING)													
"L" & "H" IN FAILURE CODES REFER TO "LOWER" & "UPPER" SPLICE PLATES													

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE 11B1
MODEL. 11B1-1
PAGE

PHASE 11 - BONDED JOINTS CONFIGURATION A - Dwg. NO. 7226-13021A-1A

SPECIMEN NO. 11A	11D01	11D02	11D03	11D04	11D05	11D06	11A01	11A02	11A03	21A03	11A05	11A06	11A07	21A04	11A09	11A10	11C01	11C02	11C03
DWG NO. 7226-13021A	1A01	1A02	1A22	1A31	1A04	1A05	1A25	1A26	1A03	1A11	1A30	1A18	1A20	1A23	1A32	1A28	1A06	1A08	1A16
TYPE OF TEST	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE	STATIC-TENSILE
R.T. RANGE °	72	74	72	73	72	72	72	74/79	72	72/73	74	75/80	74	74/76	73/74	74	67/70	66/71	77
SPEC. TEMP. RISE DURING TEST °																			
ADHEREND MATL.							8 PLY BORON 0°/±45°												
SPRUE PLATE MATL.							TITANIUM 6AL-4V ANNEALED												
ADHESIVE							EPON EA 9601-06												
SPECIMEN DIMENSIONS																			
LENGTH - IN.	3.004	3.002	3.006	3.008	3.002	3.002	3.004	3.004	3.005	3.011	3.008	3.004	3.002	3.005	3.006	3.005	3.002	3.001	3.000
AVG. WIDTH - IN.																			
OVERLAP LENGTH - IN.																			
LEFT SIDE	.74	.74	.74	.75	.74	.75	.74	.74	.74	.75	.75	.74	.74	.75	.75	.74	.74	.74	.74
RIGHT SIDE	.75	.74	.74	.75	.74	.74	.75	.75	.74	.73	.74	.75	.74	.73	.73	.75	.74	.75	.75
BONDLINE THICK., IN.	.0050	.0056	.0050	.0054	.0057	.0055	.0050	.0056	.0057	.0050	.0051	.0056	.0055	.0048	.0053	.0054	.0053	.0051	.0052
FAILURE SIDE	R	R*	L	R*	L*	R*	R	L	R	R	L	R	R	L	L	L	R	L	L
FAILURE AREA - IN. ²	2.25		2.22	2.25			2.25	2.22	2.22	2.20	2.26	2.25	2.22	2.25	2.20	2.22	2.22	2.22	2.22
STRESS LOAD																			
PAU POUNDS	8000	11200	11100	**	8800	6680	9000												
ULTIMATE BREAK																			
STRESS PAU - Psi	3600	5000	5000	**	4000	3000	4100												
STRESS RATIO (R)																			
MAX. LOAD POUNDS																			
MAX. BREAK STRESS-PSI																			
CYCLE RATE - CPM																			
FATIGUE LIFE																			
CYCLES X10 ⁻³																			
JOINT STIFFNESS																			
1.25 IN/IN WIDTH X10 ⁻³	332	328	332	236	227	204													
NOTE																			
.. SPECIMEN 11A07 NOT TESTED: WILL BE USED FOR STRAIN SURVEY AND PHOTOELASTIC STUDY																			
... THESE SPECIMENS WERE DEGRADATION SPECIMENS THAT HAD FAILED AND THEREFORE SUBSTITUTED AS BASELINE DATA TESTS.																			

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. _____
SERIAL _____
PAGE _____

TABLE 17B1
17B1-2

PHASE II - BONDED JOINT TESTS - CONFIGURATION A - ENG. NO. 7226-130211A-1A & 1C

SPECIMEN NO. 11A	11C04	11C05	12D01	12D02	12D03	12A01	12A02	12A03	12A04	12A05	12A06	12A07	12A08	12A09	12A10	12A11	12A12	12A13	12A14	12A15	12A16	12A17	12A18	12A19	12A20	12A21	12A22	12A23	12A24	12A25	12A26	12A27	12A28	12A29	12A30	12A31	12A32	12A33	12A34	12A35	12A36	12A37	12A38	12A39	12A40	12A41	12A42	12A43	12A44	12A45	12A46	12A47	12A48	12A49	12A50	12A51	12A52	12A53	12A54	12A55	12A56	12A57	12A58	12A59	12A60	12A61	12A62	12A63	12A64	12A65	12A66	12A67	12A68	12A69	12A70	12A71	12A72	12A73	12A74	12A75	12A76	12A77	12A78	12A79	12A80	12A81	12A82	12A83	12A84	12A85	12A86	12A87	12A88	12A89	12A90	12A91	12A92	12A93	12A94	12A95	12A96	12A97	12A98	12A99	12A100	12A101	12A102	12A103	12A104	12A105	12A106	12A107	12A108	12A109	12A110	12A111	12A112	12A113	12A114	12A115	12A116	12A117	12A118	12A119	12A120	12A121	12A122	12A123	12A124	12A125	12A126	12A127	12A128	12A129	12A130	12A131	12A132	12A133	12A134	12A135	12A136	12A137	12A138	12A139	12A140	12A141	12A142	12A143	12A144	12A145	12A146	12A147	12A148	12A149	12A150	12A151	12A152	12A153	12A154	12A155	12A156	12A157	12A158	12A159	12A160	12A161	12A162	12A163	12A164	12A165	12A166	12A167	12A168	12A169	12A170	12A171	12A172	12A173	12A174	12A175	12A176	12A177	12A178	12A179	12A180	12A181	12A182	12A183	12A184	12A185	12A186	12A187	12A188	12A189	12A190	12A191	12A192	12A193	12A194	12A195	12A196	12A197	12A198	12A199	12A200	12A201	12A202	12A203	12A204	12A205	12A206	12A207	12A208	12A209	12A210	12A211	12A212	12A213	12A214	12A215	12A216	12A217	12A218	12A219	12A220	12A221	12A222	12A223	12A224	12A225	12A226	12A227	12A228	12A229	12A230	12A231	12A232	12A233	12A234	12A235	12A236	12A237	12A238	12A239	12A240	12A241	12A242	12A243	12A244	12A245	12A246	12A247	12A248	12A249	12A250	12A251	12A252	12A253	12A254	12A255	12A256	12A257	12A258	12A259	12A260	12A261	12A262	12A263	12A264	12A265	12A266	12A267	12A268	12A269	12A270	12A271	12A272	12A273	12A274	12A275	12A276	12A277	12A278	12A279	12A280	12A281	12A282	12A283	12A284	12A285	12A286	12A287	12A288	12A289	12A290	12A291	12A292	12A293	12A294	12A295	12A296	12A297	12A298	12A299	12A300	12A301	12A302	12A303	12A304	12A305	12A306	12A307	12A308	12A309	12A310	12A311	12A312	12A313	12A314	12A315	12A316	12A317	12A318	12A319	12A320	12A321	12A322	12A323	12A324	12A325	12A326	12A327	12A328	12A329	12A330	12A331	12A332	12A333	12A334	12A335	12A336	12A337	12A338	12A339	12A340	12A341	12A342	12A343	12A344	12A345	12A346	12A347	12A348	12A349	12A350	12A351	12A352	12A353	12A354	12A355	12A356	12A357	12A358	12A359	12A360	12A361	12A362	12A363	12A364	12A365	12A366	12A367	12A368	12A369	12A370	12A371	12A372	12A373	12A374	12A375	12A376	12A377	12A378	12A379	12A380	12A381	12A382	12A383	12A384	12A385	12A386	12A387	12A388	12A389	12A390	12A391	12A392	12A393	12A394	12A395	12A396	12A397	12A398	12A399	12A400	12A401	12A402	12A403	12A404	12A405	12A406	12A407	12A408	12A409	12A410	12A411	12A412	12A413	12A414	12A415	12A416	12A417	12A418	12A419	12A420	12A421	12A422	12A423	12A424	12A425	12A426	12A427	12A428	12A429	12A430	12A431	12A432	12A433	12A434	12A435	12A436	12A437	12A438	12A439	12A440	12A441	12A442	12A443	12A444	12A445	12A446	12A447	12A448	12A449	12A450	12A451	12A452	12A453	12A454	12A455	12A456	12A457	12A458	12A459	12A460	12A461	12A462	12A463	12A464	12A465	12A466	12A467	12A468	12A469	12A470	12A471	12A472	12A473	12A474	12A475	12A476	12A477	12A478	12A479	12A480	12A481	12A482	12A483	12A484	12A485	12A486	12A487	12A488	12A489	12A490	12A491	12A492	12A493	12A494	12A495	12A496	12A497	12A498	12A499	12A500	12A501	12A502	12A503	12A504	12A505	12A506	12A507	12A508	12A509	12A510	12A511	12A512	12A513	12A514	12A515	12A516	12A517	12A518	12A519	12A520	12A521	12A522	12A523	12A524	12A525	12A526	12A527	12A528	12A529	12A530	12A531	12A532	12A533	12A534	12A535	12A536	12A537	12A538	12A539	12A540	12A541	12A542	12A543	12A544	12A545	12A546	12A547	12A548	12A549	12A550	12A551	12A552	12A553	12A554	12A555	12A556	12A557	12A558	12A559	12A560	12A561	12A562	12A563	12A564	12A565	12A566	12A567	12A568	12A569	12A570	12A571	12A572	12A573	12A574	12A575	12A576	12A577	12A578	12A579	12A580	12A581	12A582	12A583	12A584	12A585	12A586	12A587	12A588	12A589	12A590	12A591	12A592	12A593	12A594	12A595	12A596	12A597	12A598	12A599	12A600	12A601	12A602	12A603	12A604	12A605	12A606	12A607	12A608	12A609	12A610	12A611	12A612	12A613	12A614	12A615	12A616	12A617	12A618	12A619	12A620	12A621	12A622	12A623	12A624	12A625	12A626	12A627	12A628	12A629	12A630	12A631	12A632	12A633	12A634	12A635	12A636	12A637	12A638	12A639	12A640	12A641	12A642	12A643	12A644	12A645	12A646	12A647	12A648	12A649	12A650	12A651	12A652	12A653	12A654	12A655	12A656	12A657	12A658	12A659	12A660	12A661	12A662	12A663	12A664	12A665	12A666	12A667	12A668	12A669	12A670	12A671	12A672	12A673	12A674	12A675	12A676	12A677	12A678	12A679	12A680	12A681	12A682	12A683	12A684	12A685	12A686	12A687	12A688	12A689	12A690	12A691	12A692	12A693	12A694	12A695	12A696	12A697	12A698	12A699	12A700	12A701	12A702	12A703	12A704	12A705	12A706	12A707	12A708	12A709	12A710	12A711	12A712	12A713	12A714	12A715	12A716	12A717	12A718	12A719	12A720	12A721	12A722	12A723	12A724	12A725	12A726	12A727	12A728	12A729	12A730	12A731	12A732	12A733	12A734	12A735	12A736	12A737	12A738	12A739	12A740	12A741	12A742	12A743	12A744	12A745	12A746	12A747	12A748	12A749	12A750	12A751	12A752	12A753	12A754	12A755	12A756	12A757	12A758	12A759	12A760	12A761	12A762	12A763	12A764	12A765	12A766	12A767	12A768	12A769	12A770	12A771	12A772	12A773	12A774	12A775	12A776	12A777	12A778	12A779	12A780	12A781	12A782	12A783	12A784	12A785	12A786	12A787	12A788	12A789	12A790	12A791	12A792	12A793	12A794	12A795	12A796	12A797	12A798	12A799	12A800	12A801	12A802	12A803	12A804	12A805	12A806	12A807	12A808	12A809	12A810	12A811	12A812	12A813	12A814	12A815	12A816	12A817	12A818	12A819	12A820	12A821	12A822	12A823	12A824	12A825	12A826	12A827	12A828	12A829	12A830	12A831	12A832	12A833	12A834	12A835	12A836	12A837	12A838	12A839	12A840	12A841	12A842	12A843	12A844	12A845	12A846	12A847	12A848	12A849	12A850	12A851	12A852	12A853	12A854	12A855	12A856	12A857	12A858	12A859	12A860	12A861	12A862	12A863	12A864	12A865	12A866	12A867	12A868	12A869	12A870	12A871	12A872	12A873	12A874	12A875	12A876	12A877	12A878	12A879	12A880	12A881	12A882	12A883	12A884	12A885	12A886	12A887	12A888	12A889	12A890	12A891	12A892	12A893	12A894	12A895	12A896	12A897	12A898	12A899	12A900	12A901	12A902	12A903	12A904	12A905	12A906	12A907	12A908	12A909	12A910	12A911	12A912	12A913	12A914	12A915	12A916	12A917	12A918	12A919	12A920	12A921	12A922	12A923	12A924	12A925	12A926	12A927	12A928	12A929	12A930	12A931	12A932	12A933	12A934	12A935	12A936	12A937	12A938	12A939	12A940	12A941	12A942	12A943	12A944	12A945	12A946	12A947	12A948	12A949	12A950	12A951	12A952	12A953	12A954	12A955	12A956	12A957	12A958	12A959	12A960	12A961	12A962	12A963	12A964	12A965	12A966	12A967	12A968	12A969	12A970	12A971	12A972	12A973	12A974	12A975	12A976	12A977	12A978	12A979	12A980	12A981	12A982	12A983	12A984	12A985	12A986	12A987	12A988	12A989	12A990	12A991	12A992	12A993	12A994	12A995	12A996	12A997	12A998	12A999	12A1000	12A1001	12A1002	12A1003	12A1004	12A1005	12A1006	12A1007	12A1008	12A1009	12A1010	12A1011	12A1012	12A1013	12A1014	12A1015	12A1016	12A1017	12A1018	12A1019	12A1020	12A1021	12A1022	12A1023	12A1024	12A1025	12A1026	12A1027	12A1028	12A1029	12A1030	12A1031	12A1032	12A1033	12A1034	12A1035	12A1036	12A1037	12A1038	12A1039	12A1040	12A1041	12A1042	12A1043	12A1044	12A1045	12A1046	12A1047	12A1048	12A1049	12A1050	12A1051	12A1052	12A1053	12A1054	12A1055	12A1056	12A1057	12A1058	12A1059	12A1060	12A1061	12A1062	12A1063	12A1064	12A1065	12A1066	12A1067	12A1068	12A1069	12A1070	12A1071	12A1072	12A1073	12A1074	12A1075	12A1076	12A1077	12A1078	12A1079	12A1080	12A1081	12A1082	12A1083	12A1084	12A1085	12A1086	12A1087	12A1088	12A1089	12A1090	12A1091	12A1092	12A1093	12A1094	12
------------------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	----

PHASE II - BONDED JOINT TESTS - CONFIGURATION A - DWG. NO. 7226-13021A-1A

[illegible]

NOTES:	①	FAILURE OCCURRED DURING THE FIRST APPLICATION OF THIS LOAD.
--------	---	---

② THIS LOAD LEVEL WAS ADDED FOR TESTING CONVENIENCE ONLY.

③ TABLES IN AFFDL-TR-71-46

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

TABLE II - BONDED JOINTS CONFIGURATION A - DNG, INC. 7226-130211A-11A

SPECIMEN NO. 11A	91D01	91D02	91D03	91D04	91D05	91D06	91A01	91A02	91A03	91A04	91A05	91C01	91C02	91C03	91C04	91C05
DNG. NO. 7226-130211A	11A01	11A02	11A03	11A04	11A05	11A06	11A07	11A08	11A09	11A10	11A11	11A12	11A13	11A14	11A15	11A16
TYPE OF TEST	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
R.T. RANGE °	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73	73
WPC. TEMP RISE																
ENDING TEST °																
ADHEREND MATL.																
SPLICE PLATE MATL.																
ADHESIVE																
SPECIMEN DIMENSIONS																
LENGTH - IN.																
WIDE - IN.																
OVERLAP LENGTH - IN.																
LEFT SIDE																
RIGHT SIDE																
BONDLINE THICK. IN.																
FAILURE SIDE																
FAILURE AREA - IN. ²																
ULTIMATE LOAD																
PSI POUNDS																
ULTIMATE SHEAR																
STRESS P44 - PSI																
STRESS RATIO (R)																
MAX. LOAD POUNDS																
MAX. SHEAR STRESS-PSI																
CYCLE RATE - CPM																
PARTICLE LIFE																
CYCLES X10 ⁻³																
JOINT STIFFNESS																
(LBS/IN/IN WIDTH)10 ⁻³																
NOTES:																
0 FAILURE OCCURRED IN ADHEREND.																
NR NOT RECORDED.																
1 NO FAILURE TEST DISCONTINUED AFTER 10 CYCLES.																
2 SEE NOTE 2 TABLE B3 PAGE 6.																

LOCKHEED-GEORGIA COMPANY
 A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE II BONDED JOINTS - CONFIGURATION B - DMO, NO. 7226-13021B-1A

TESTING NO.	11A01	11A02	11A03	11A04	11A05	11A06	11A07	11A08	11A09	11A10	11A11	11A12	11A13	11A14	11A15
DMO. NO. 7226-13021B	11A01	11A02	11A03	11A04	11A05	11A06	11A07	11A08	11A09	11A10	11A11	11A12	11A13	11A14	11A15
TYPE OF TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST	STATIC TEST
R.T. RANGE °F	70/70	70/70	70/70	70/70	70/70	70/70	70/70	70/70	70/70	70/70	70/70	70/70	70/70	70/70	70/70
SPC. TEMP. °F	5	3	6	4	8	16 PIN	16 PIN	16 PIN	16 PIN	16 PIN	16 PIN	16 PIN	16 PIN	16 PIN	16 PIN
DATE TEST															
ADHESIVE MATERIAL 1															
ADHESIVE MATERIAL 2															
ADHESIVE															
SECTION DIMENSIONS															
LENGTH - IN.	3.009	3.010	3.009	3.008	3.009	3.008	3.007	3.007	3.008	3.008	3.006	3.006	3.006	3.008	
AVG. WIDTH - IN.	1.50	1.50	1.54	1.54	1.52	1.54	1.50	1.50	1.53	1.53	1.53	1.53	1.53	1.54	
OVERLAP LENGTH - IN.															
BONDING THICK. - IN.															
STEP 1	.0055	.0055	.0055	.0055	.0055	.0055	.0055	.0055	.0055	.0055	.0055	.0055	.0055	.0055	
STEP 2	.0060	.0060	.0059	.0060	.0059	.0060	.0059	.0060	.0060	.0060	.0059	.0059	.0059	.0060	
STEP 3	.0059	.0060	.0059	.0060	.0060	.0060	.0060	.0060	.0059	.0060	.0060	.0060	.0060	.0059	
FAILURE AREA - IN. 2	#B	#B	#B	#B	#B	#B	#B	#B	#B	#B	#B	#B	#B	#B	
ULTIMATE LOAD	16700	17200	16500	17300	23000	18500	19500	19500							
PEAK FORCE	3700	3700	3700	3900	5000	4100	4200	4200							
STRESS PA - PSI															
STRESS RATIO (R)															
MAX. LOAD POUNDS	4070	4180	4180	4000	6520										
MAX. SHEAR STRESS-PSI	900	1400	1400	900	1400										
CYCLE RATE - CPH	1800	1600	1625	1750	1800										
FACTOR LIFE															
CYCLES $\times 10^{-3}$	9000	105	304	9000	108										
JOINT STIFFNESS															
(IN/IN/IN YDIN) $\times 10^{-3}$	653	550	660	680	657	667	650	650							
NOTES:	1 - Failure occurred in bond adherend. 2 - Titanium adherend failed in buckling. 3 - Boron adherend failed in buckling at top.														

PHASE II BONDED JOINTS - CONFIGURATION B - DWG. NO. 7226-1302IB-1B42A

STRUCTURE NO. IIB	12D01	12D02	12D03	12A01	12A02	12A03	12A04	12A05	31D01	31D02	31D03	31A01	31A02	31A03	31A04	31A05
DWG. NO. 7226-1302IB	12D01	12D02	12D03	12A01	12A02	12A03	12A04	12A05	31D01	31D02	31D03	31A01	31A02	31A03	31A04	31A05
TYPE OF TEST	76	76	76	76	75/76	75	76/76	75	76	76	76	76/75	76/75	70/75	73/75	72/75
P.S. BATH °F	-	-	-	-	3	3	6	3	-	-	-	3	6	6	5	5
STRESS, T.E.P., PSI	-	-	-	-	1	1	3	3	-	-	-	3	6	6	5	5
LOADING TEST °F	-	-	-	-	3	3	6	3	-	-	-	3	6	6	5	5
ADHESIVE MATERIAL 1	-	-	-	-	-	-	-	16 PLY BONDON OF 3/4" S	-	-	-	-	-	-	-	-
ADHESIVE MATERIAL 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ADHESIVE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EXPOSURE DIMENSIONS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LENGTH - IN.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVG. WIDTH - IN.	3.008	3.002	2.994	2.993	3.006	3.007	2.999	2.993	3.007	3.008	3.001	3.008	3.006	3.008	3.010	3.002
OVERLAP LENGTH - IN.	1.56	1.54	1.55	1.56	1.55	1.52	1.52	1.55	1.09	1.09	1.10	1.10	1.09	1.07	1.09	1.10
INDICATOR TRUCK - IN.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STEP 1	.0055	.0055	.0055	.0050	.0055	.0055	.0055	.0055	.0059	.0059	.0049	.0050	.0055	.0059	.0055	.0050
STEP 2	.0059	.0050	.0059	.0049	.0050	.0059	.0059	.0059	.0059	.0059	.0050	.0059	.0059	.0059	.0059	.0050
STEP 3	.0055	.0055	.0055	.0050	.0059	.0059	.0059	.0055	.0050	.0059	.0050	.0059	.0059	.0059	.0050	.0050
PAYOFF AREA - IN. ²	.9A	.9A	.9A	.9A	.9A	.9A	.9A	.9A	.9B	.9B	.9B	3.31	3.28	3.22	3.28	3.30
WETWEAR LOAD	15200	14800	14700	-	-	-	-	-	17700	16500	16600	-	-	-	-	-
WETWEAR SHEAR	3200	3200	3200	-	-	-	-	-	5400	5000	5000	-	-	-	-	-
STRESS PER - PSI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STRESS RATIO (R)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAX. LOAD POUNDS	6070	6060	5940	5930	6030	-	-	-	-	-	-	4630	4590	4510	4590	4480
MAX. SHEAR STRESS-PSI	1300	1300	1300	1300	1300	-	-	-	-	-	-	1400	1400	1400	1400	1400
CYCLE RATE - GPM	1800	1550	1525	1775	1800	-	-	-	-	-	-	1800	1800	1750	1800	1775
PAYOFF LIFE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CYCLES x 10 ⁻³	14	22	26	28	21	-	-	-	-	-	-	1440	3770	11340	860	939
JOINT STRENGTH	480	493	510	-	-	-	-	-	643	633	637	-	-	-	-	-
(1480/IN. WIDTH) 10 ⁻³	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NOTES: 9A - Failures occurred in aluminum adherend.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9B - Failures occurred in porous adherend.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE III - BONDED JOINTS CONFIGURATION A

Specimen No. 111A-	11D2	11D4	11D6	11D5	11A1	11B1	11C1	12D2	12D3	12D4	12A1	12B1
111A-1	111A-1	111A-1	111A-1	111A-1	111A-1	111A-1	111A-1	111A-1	111A-1	111A-1	111A-1	111A-1
Type of Test	Static Tension	Static Tension	Static Tension	Static Tension	Static Tension	Static Tension	Static Tension	Static Tension	Static Tension	Static Tension	Static Tension	Static Tension
R.T. Range °F	76	76	76	76	68	73	70	75	75	74	70	72
Spec. Test. Note												
During Test	0	0	0	0	0	0	3	0	0	0	0	0
Adherent Matl.			Boron 8 Ply 0.2 45						Boron 8 Ply 0.2 45			
Splice Plate Matl.			Ti-6-4						AL 7075-T-6			
Adhesive			EA9601 - .06MT						EA9601 - .06 MT			
Specimen Dimensions												
Length	1.000	1.008	18.0 In. Nom.	1.001	10.00	10.00	10.00	1.001	18.0 In. Nom.	1.000	10.00	10.00
Width												
Overlap Length												
Left Side	.73	.75	.75	.74	.74	.74	.74	.76	.76	.74	.74	.75
Right Side	.75	.74	.75	.74	.74	.75	.75	.74	.74	.75	.75	.75
Bondline Thick. (Mils)			(SEE TABLE A12)						(SEE TABLE A12)			
Failure Side	L	L	L	-	L	R	L	R	R	R	R	R
Failure Area - IN. ²	.730	.746	.751	.741	7.40	7.40	7.40	.741	.740	.748	7.40	7.50
Ultimate Load	3890	3750	3408	3360				3670	3860	3860		
Tau - Pounds												
Ultimate Shear												
Tau - Stress	5300	5000	4500	4500				5000	5200	5200		
Stress Ratio (R)					0.1	-1.0	10.0				0.1	-1.0
Max. Load Pounds					8140	5920	-1184				9620	6000
Max. Shear Stress					1100	800	-160				1300	800
Cycle Rate - CPM					300	300	490				300	300
Fatigue Life												
Cycles X 10 ⁻³					195.9	11.4	1090				9.2	9.57
Joint Stiffness (lb./in. width) 10 ⁻³	338	348	340	325				359	335	323		

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE III - BONDED JOINTS CONFIGURATION B

Specimen No., ID#	11D1	11D2	11D3	11A1	11B1
DAG #7226-130213	1A01-1	1A02-1	1A03-1	1A01	1A03
Type of Test	Static	Static	Static	Static	Static
R. T. Range °F	73	73	74	75	75
Spec. Temp. Rise				2	2
Adherent Material 1	Boron 15 Ply	0/2 45			
Adherent Material 2	Ti-6-4				
Adhesive	EA9601 + .945				
Specimen Dimensions					
Length - In.			18.0 In. Nom.		
Width - In.	1.003	1.001	1.003	10.00	10.00
Bondline Thick.	(SEE TABLE A13)				
Failure Area - IN. ²	1.48	1.47	1.48	14.9	14.8
Ultimate Load					
Pcu - Lbs.	4990	5490	5990		
Ultimate Shear					
Pcu - PSI	3400	3700	4000		
Stress Ratio (R)			0.1	-1.0	
Max. Load - Lbs.			20860	11840	
Max. Shear - PSI			1400	800	
Cycle Rate - CPM			420	180	
Fatigue Life					
Cycle X 10 ⁻³			143	500	
Joint Stiffness					
(LBS/IN/IN WIDTH)10 ⁻³	668	659	612		

PHASE I - MECHANICAL JOINTS - CONFIGURATION B - Dwg. NO. 7226-13021B-1A

SPECIMEN NO.	12	111001	111003	111005	111007	111009	111011	111013	111015	111017	111019	111021	111023	111025	111027	111029	111031	111033	111035	111037	111039	111041	111043	111045	111047	111049	111051	111053	111055	111057	111059	111061	111063	111065	111067	111069	111071	111073	111075	111077	111079	111081	111083	111085	111087	111089	111091	111093	111095	111097	111099	111101	111103	111105	111107	111109	111111	111113	111115	111117	111119	111121	111123	111125	111127	111129	111131	111133	111135	111137	111139	111141	111143	111145	111147	111149	111151	111153	111155	111157	111159	111161	111163	111165	111167	111169	111171	111173	111175	111177	111179	111181	111183	111185	111187	111189	111191	111193	111195	111197	111199	111201	111203	111205	111207	111209	111211	111213	111215	111217	111219	111221	111223	111225	111227	111229	111231	111233	111235	111237	111239	111241	111243	111245	111247	111249	111251	111253	111255	111257	111259	111261	111263	111265	111267	111269	111271	111273	111275	111277	111279	111281	111283	111285	111287	111289	111291	111293	111295	111297	111299	111301	111303	111305	111307	111309	111311	111313	111315	111317	111319	111321	111323	111325	111327	111329	111331	111333	111335	111337	111339	111341	111343	111345	111347	111349	111351	111353	111355	111357	111359	111361	111363	111365	111367	111369	111371	111373	111375	111377	111379	111381	111383	111385	111387	111389	111391	111393	111395	111397	111399	111401	111403	111405	111407	111409	111411	111413	111415	111417	111419	111421	111423	111425	111427	111429	111431	111433	111435	111437	111439	111441	111443	111445	111447	111449	111451	111453	111455	111457	111459	111461	111463	111465	111467	111469	111471	111473	111475	111477	111479	111481	111483	111485	111487	111489	111491	111493	111495	111497	111499	111501	111503	111505	111507	111509	111511	111513	111515	111517	111519	111521	111523	111525	111527	111529	111531	111533	111535	111537	111539	111541	111543	111545	111547	111549	111551	111553	111555	111557	111559	111561	111563	111565	111567	111569	111571	111573	111575	111577	111579	111581	111583	111585	111587	111589	111591	111593	111595	111597	111599	111601	111603	111605	111607	111609	111611	111613	111615	111617	111619	111621	111623	111625	111627	111629	111631	111633	111635	111637	111639	111641	111643	111645	111647	111649	111651	111653	111655	111657	111659	111661	111663	111665	111667	111669	111671	111673	111675	111677	111679	111681	111683	111685	111687	111689	111691	111693	111695	111697	111699	111701	111703	111705	111707	111709	111711	111713	111715	111717	111719	111721	111723	111725	111727	111729	111731	111733	111735	111737	111739	111741	111743	111745	111747	111749	111751	111753	111755	111757	111759	111761	111763	111765	111767	111769	111771	111773	111775	111777	111779	111781	111783	111785	111787	111789	111791	111793	111795	111797	111799	111801	111803	111805	111807	111809	111811	111813	111815	111817	111819	111821	111823	111825	111827	111829	111831	111833	111835	111837	111839	111841	111843	111845	111847	111849	111851	111853	111855	111857	111859	111861	111863	111865	111867	111869	111871	111873	111875	111877	111879	111881	111883	111885	111887	111889	111891	111893	111895	111897	111899	111901	111903	111905	111907	111909	111911	111913	111915	111917	111919	111921	111923	111925	111927	111929	111931	111933	111935	111937	111939	111941	111943	111945	111947	111949	111951	111953	111955	111957	111959	111961	111963	111965	111967	111969	111971	111973	111975	111977	111979	111981	111983	111985	111987	111989	111991	111993	111995	111997	111999	112001	112003	112005	112007	112009	112011	112013	112015	112017	112019	112021	112023	112025	112027	112029	112031	112033	112035	112037	112039	112041	112043	112045	112047	112049	112051	112053	112055	112057	112059	112061	112063	112065	112067	112069	112071	112073	112075	112077	112079	112081	112083	112085	112087	112089	112091	112093	112095	112097	112099	112101	112103	112105	112107	112109	112111	112113	112115	112117	112119	112121	112123	112125	112127	112129	112131	112133	112135	112137	112139	112141	112143	112145	112147	112149	112151	112153	112155	112157	112159	112161	112163	112165	112167	112169	112171	112173	112175	112177	112179	112181	112183	112185	112187	112189	112191	112193	112195	112197	112199	112201	112203	112205	112207	112209	112211	112213	112215	112217	112219	112221	112223	112225	112227	112229	112231	112233	112235	112237	112239	112241	112243	112245	112247	112249	112251	112253	112255	112257	112259	112261	112263	112265	112267	112269	112271	112273	112275	112277	112279	112281	112283	112285	112287	112289	112291	112293	112295	112297	112299	112301	112303	112305	112307	112309	112311	112313	112315	112317	112319	112321	112323	112325	112327	112329	112331	112333	112335	112337	112339	112341	112343	112345	112347	112349	112351	112353	112355	112357	112359	112361	112363	112365	112367	112369	112371	112373	112375	112377	112379	112381	112383	112385	112387	112389	112391	112393	112395	112397	112399	112401	112403	112405	112407	112409	112411	112413	112415	112417	112419	112421	112423	112425	112427	112429	112431	112433	112435	112437	112439	112441	112443	112445	112447	112449	112451	112453	112455	112457	112459	112461	112463	112465	112467	112469	112471	112473	112475	112477	112479	112481	112483	112485	112487	112489	112491	112493	112495	112497	112499	112501	112503	112505	112507	112509	112511	112513	112515	112517	112519	112521	112523	112525	112527	112529	112531	112533	112535	112537	112539	112541	112543	112545	112547	112549	112551	112553	112555	112557	112559	112561	112563	112565	112567	112569	112571	112573	112575	112577	112579	112581	112583	112585	112587	112589	112591	112593	112595	112597	112599	112601	112603	112605	112607	112609	112611	112613	112615	112617	112619	112621	112623	112625	112627	112629	112631	112633	112635	112637	112639	112641	112643	112645	112647	112649	112651	112653	112655	112657	112659	112661	112663	112665	112667	112669	112671	112673	112675	112677	112679	112681	112683	112685	112687	112689	112691	112693	112695	112697	112699	112701	112703	112705	112707	112709	112711	112713	112715	112717	112719	112721	112723	112725	112727	112729	112731	112733	112735	112737	112739	112741	112743	112745	112747	112749	112751	112753	112755	112757	112759	112761	112763	112765	112767	112769	112771	112773	112775	112777	112779	112781	112783	112785	112787	112789	112791	112793	112795	112797	112799	112801	112803	112805	112807	112809	112811	112813	112815	112817	112819	112821	112823	112825	112827	112829	112831	112833	112835	112837	112839	112841	112843	112845	112847	112849	112851	112853	112855	112857	112859	112861	112863	112865	112867	112869	112871	112873	112875	112877	112879	112881	112883	112885	112887	112889	112891	112893	112895	112897	112899	112901	112903	112905	112907	112909	112911	112913	112915	112917	112919	112921	112923	112925	112927	112929	112931	112933	112935	112937	112939	112941	112943	112945	112947	112949	112951	112953	112955	112957	112959	112961	112963	112965	112967	112969	112971	112973	112975	112977	112979	112981	112983	112985	112987	112989	112991	112993	112995	112997	112999	113001	113003	113005	113007	113009	113011	113013	113015	113017	113019	113021	113023	113025	113027	113029	113031	113033	113035	113037	113039	113041	113043	113045	113047	113049	113051	113053	113055	113057	113059	113061	113063	113065	113067	113069	113071	113073	113075	113077	113079	113081	113083	113085	113087	113089	113091	113093	113095	113097	113099	113101	113103	113105	113107	113109	113111	113113	113115	113117	113119	113121	113123	113125	113127	113129	113131	113133	113135	113137	113139	113141	113143	113145	113147	113149	113151	113153	113155	113157	113159	113161	113163	113165	113167	113169	113171	113173	113175	113177	113179	113181	113183	113185	113187	113189	113191	113193	113195	113197	113199	113201	113203
--------------	----	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. 1193
MODEL 2
PAGE

PHASE I - MECHANICAL JOINTS - CONFIGURATION E - DRG. NO. 7226-1302E-1A

DESCRIPTION	111002	111004	111001	111002	111003	111004	111005	111006	111007	111008	111009	111010	111011	111012	111013	111014	111015	111016	111017	111018	111019	111020	111021	111022	111023	111024	111025	111026	111027	111028	111029	111030	111031	111032	111033	111034	111035	111036	111037	111038	111039	111040	111041	111042	111043	111044	111045	111046	111047	111048	111049	111050	111051	111052	111053	111054	111055	111056	111057	111058	111059	111060	111061	111062	111063	111064	111065	111066	111067	111068	111069	111070	111071	111072	111073	111074	111075	111076	111077	111078	111079	111080	111081	111082	111083	111084	111085	111086	111087	111088	111089	111090	111091	111092	111093	111094	111095	111096	111097	111098	111099	111100	111101	111102	111103	111104	111105	111106	111107	111108	111109	111110	111111	111112	111113	111114	111115	111116	111117	111118	111119	111120	111121	111122	111123	111124	111125	111126	111127	111128	111129	111130	111131	111132	111133	111134	111135	111136	111137	111138	111139	111140	111141	111142	111143	111144	111145	111146	111147	111148	111149	111150	111151	111152	111153	111154	111155	111156	111157	111158	111159	111160	111161	111162	111163	111164	111165	111166	111167	111168	111169	111170	111171	111172	111173	111174	111175	111176	111177	111178	111179	111180	111181	111182	111183	111184	111185	111186	111187	111188	111189	111190	111191	111192	111193	111194	111195	111196	111197	111198	111199	111200	111201	111202	111203	111204	111205	111206	111207	111208	111209	111210	111211	111212	111213	111214	111215	111216	111217	111218	111219	111220	111221	111222	111223	111224	111225	111226	111227	111228	111229	111230	111231	111232	111233	111234	111235	111236	111237	111238	111239	111240	111241	111242	111243	111244	111245	111246	111247	111248	111249	111250	111251	111252	111253	111254	111255	111256	111257	111258	111259	111260	111261	111262	111263	111264	111265	111266	111267	111268	111269	111270	111271	111272	111273	111274	111275	111276	111277	111278	111279	111280	111281	111282	111283	111284	111285	111286	111287	111288	111289	111290	111291	111292	111293	111294	111295	111296	111297	111298	111299	111300	111301	111302	111303	111304	111305	111306	111307	111308	111309	111310	111311	111312	111313	111314	111315	111316	111317	111318	111319	111320	111321	111322	111323	111324	111325	111326	111327	111328	111329	111330	111331	111332	111333	111334	111335	111336	111337	111338	111339	111340	111341	111342	111343	111344	111345	111346	111347	111348	111349	111350	111351	111352	111353	111354	111355	111356	111357	111358	111359	111360	111361	111362	111363	111364	111365	111366	111367	111368	111369	111370	111371	111372	111373	111374	111375	111376	111377	111378	111379	111380	111381	111382	111383	111384	111385	111386	111387	111388	111389	111390	111391	111392	111393	111394	111395	111396	111397	111398	111399	111400	111401	111402	111403	111404	111405	111406	111407	111408	111409	111410	111411	111412	111413	111414	111415	111416	111417	111418	111419	111420	111421	111422	111423	111424	111425	111426	111427	111428	111429	111430	111431	111432	111433	111434	111435	111436	111437	111438	111439	111440	111441	111442	111443	111444	111445	111446	111447	111448	111449	111450	111451	111452	111453	111454	111455	111456	111457	111458	111459	111460	111461	111462	111463	111464	111465	111466	111467	111468	111469	111470	111471	111472	111473	111474	111475	111476	111477	111478	111479	111480	111481	111482	111483	111484	111485	111486	111487	111488	111489	111490	111491	111492	111493	111494	111495	111496	111497	111498	111499	111500	111501	111502	111503	111504	111505	111506	111507	111508	111509	111510	111511	111512	111513	111514	111515	111516	111517	111518	111519	111520	111521	111522	111523	111524	111525	111526	111527	111528	111529	111530	111531	111532	111533	111534	111535	111536	111537	111538	111539	111540	111541	111542	111543	111544	111545	111546	111547	111548	111549	111550	111551	111552	111553	111554	111555	111556	111557	111558	111559	111560	111561	111562	111563	111564	111565	111566	111567	111568	111569	111570	111571	111572	111573	111574	111575	111576	111577	111578	111579	111580	111581	111582	111583	111584	111585	111586	111587	111588	111589	111590	111591	111592	111593	111594	111595	111596	111597	111598	111599	111600	111601	111602	111603	111604	111605	111606	111607	111608	111609	111610	111611	111612	111613	111614	111615	111616	111617	111618	111619	111620	111621	111622	111623	111624	111625	111626	111627	111628	111629	111630	111631	111632	111633	111634	111635	111636	111637	111638	111639	111640	111641	111642	111643	111644	111645	111646	111647	111648	111649	111650	111651	111652	111653	111654	111655	111656	111657	111658	111659	111660	111661	111662	111663	111664	111665	111666	111667	111668	111669	111670	111671	111672	111673	111674	111675	111676	111677	111678	111679	111680	111681	111682	111683	111684	111685	111686	111687	111688	111689	111690	111691	111692	111693	111694	111695	111696	111697	111698	111699	111700	111701	111702	111703	111704	111705	111706	111707	111708	111709	111710	111711	111712	111713	111714	111715	111716	111717	111718	111719	111720	111721	111722	111723	111724	111725	111726	111727	111728	111729	111730	111731	111732	111733	111734	111735	111736	111737	111738	111739	111740	111741	111742	111743	111744	111745	111746	111747	111748	111749	111750	111751	111752	111753	111754	111755	111756	111757	111758	111759	111760	111761	111762	111763	111764	111765	111766	111767	111768	111769	111770	111771	111772	111773	111774	111775	111776	111777	111778	111779	111780	111781	111782	111783	111784	111785	111786	111787	111788	111789	111790	111791	111792	111793	111794	111795	111796	111797	111798	111799	111800	111801	111802	111803	111804	111805	111806	111807	111808	111809	111810	111811	111812	111813	111814	111815	111816	111817	111818	111819	111820	111821	111822	111823	111824	111825	111826	111827	111828	111829	111830	111831	111832	111833	111834	111835	111836	111837	111838	111839	111840	111841	111842	111843	111844	111845	111846	111847	111848	111849	111850	111851	111852	111853	111854	111855	111856	111857	111858	111859	111860	111861	111862	111863	111864	111865	111866	111867	111868	111869	111870	111871	111872	111873	111874	111875	111876	111877	111878	111879	111880	111881	111882	111883	111884	111885	111886	111887	111888	111889	111890	111891	111892	111893	111894	111895	111896	111897	111898	111899	111900	111901	111902	111903	111904	111905	111906	111907	111908	111909	111910	111911	111912	111913	111914	111915	111916	111917	111918	111919	111920	111921	111922	111923	111924	111925	111926	111927	111928	111929	111930	111931	111932	111933	111934	111935	111936	111937	111938	111939	111940	111941	111942	111943	111944	111945	111946	111947	111948	111949	111950	111951	111952	111953	111954	111955	111956	111957	111958	111959	111960	111961	111962	111963	111964	111965	111966	111967	111968	111969	111970	111971	111972	111973	111974	111975	111976	111977	111978	111979	111980	111981	111982	111983	111984	111985	111986	111987	111988	111989	111990	111991	111992	111993	111994	111995	111996	111997	111998	111999	112000	112001	112002	112003	112004	112005	112006	112007	112008	112009	112010	112011	112012	112013	112014	112015	112016	112017	112018	112019	112020	112021	112022	112023	112024	112025	112026	112027	112028	112029	112030	112031	112032	112033	112034	112035	112036	112037	112038	112039	112040	112041	112042	112043	112044	112045	112046	112047	112048	112049	112050	112051	112052	112053	112054	112055	112056	112057	112058	112059	112060	112061	112062	112063	112064	112065	112066	112067	112068	112069	112070	112071	112072	112073	112074	112075	112076	112077	112078	112079	112080	112081	112082	112083	112084	112085	112086	112087	112088	112089	112090	112091	112092	112093	112094	112095	112096	112097	112098	112099	112100	112101	112102	112103	112104
-------------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

PHASE I - MECHANICAL JOINTS - CONFIGURATION E - DWG. NO. 7226-1302E-1A

[illegible]

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. 1731
PAGE 1

TABLE 1 - MECHANICAL CYCLES - CONFIGURATION B - DMO, MD, 7226-1302B-1A

PAGE 1 - MECHANICAL COILS - COMPRESSION B - DMO, MD, 7226-1302B-1A												
SPECIMEN NO. IN	611P01	611P02	611P03	611P04	611P05	611P06	611P07					
DMO, MD, 7226-1302B	1A08	1A16	1A36	1A35	1A30	1A43	1A53					
TYPE OF TEST	FATIGUE - BLOCK SPECIMEN											
1. 2. BUREAU	69/76	70/76	69/79	68/76	70/79	70	70					
3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 841. 842. 843. 844. 845. 846. 847. 848. 849. 850. 851. 852. 853. 854. 855. 856. 857. 858. 859. 860. 861. 862. 863. 864. 865. 866. 867. 868. 869. 870. 871. 872. 873. 874. 875. 876. 877. 878. 879. 880. 881. 882. 883. 884. 885. 886. 887. 888. 889. 890. 891. 892. 893. 894. 895. 896. 897. 898. 899. 900. 901. 902. 903. 904. 905. 906. 907. 908. 909. 910. 911. 912. 913. 914. 915. 916. 917. 918. 919. 920. 921. 922. 923. 924. 925. 926. 927. 928. 929. 930. 931. 932. 933. 934. 935. 936. 937. 938. 939. 940. 941. 942. 943. 944. 945. 946. 947. 948. 949. 950. 951. 952. 953. 954. 955. 956. 957. 958. 959. 960. 961. 962. 963. 964. 965. 966. 967. 968. 969. 970. 971. 972. 973. 974. 975. 976. 977. 978. 979. 980. 981. 982. 983. 984. 985. 986. 987. 988. 989. 990. 991. 992. 993. 994. 995. 996. 997. 998. 999. 1000.												
STRAP MATERIAL	8-PLY FIBER, 0°/90° ± TWO STRETCHES											
SPRICE PLATE MOUNT	STRETCHING BAR, 10-14											
STRAP MATERIAL	STRETCHING BAR, 10-14											
JOINT MATERIAL	STRETCHING BAR, 10-14											
STRETCHING LENGTHS - IN.	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCHING BAR, 10-14											
8-PLY FIBER, 0°/90° ± TWO STRETCHES	STRETCH											

PHASE I - MECHANICAL JOINTS - CONFIGURATION B - Dwg. NO. 7226-13021E-1A

ITEM NO.	ITEM	611001	611002	611003	611004	611005	611006	LOAD NO.	LOAD LEVEL (g)	LOAD (LBS.)	LOAD TIME (SEC.)
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	1	-3.6	-1500	0.3
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	2	-3.2	-1150	0.2
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	3	-2.8	-1110	0.1
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	4	-2.4	-965	0.3
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	5	-2.0	-720	0.2
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	6	-1.6	-575	0.1
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	7	-1.2	-430	0.3
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	8	-1.0	-350	0.2
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	9	-0.8	-290	0.1
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	10	-0.4	-145	0.3
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	11	0	0	0.2
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	12	1.0	360	0.1
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	13	2.56	920	0.3
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	14	3.0	1080	0.2
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	15	4.0	1440	0.1
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	16	5.0	1800	0.3
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	17	6.0	2160	0.2
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	18	7.0	2520	0.1
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	19	8.0	2870	0.4
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	20	8.0	2880	0.4
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	21	8.0	2880	0.4
226-13221E	1A7	1A7	1A7	1A7	1A7	1A7	1A7	22 (2)	0	0	2.0

NOTES: (1) Tables in A-20-7-7-444.
(2) This Load Level was Used for Casting Convenience Only.

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. 1761
PAGE 6

PHASE 1 - MECHANICAL JOINTS - CONFIGURATION B - Dwg. NO. 7295-15021B-1A SPECTRUM LOAD DETAILS

SPECTRUM NO. 1												SPECTRUM NO. 2												SPECTRUM NO. 3												SPECTRUM NO. 4												SPECTRUM NO. 5												NO. OF CYCLES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
LOAD		CYCLIC		1 'g' = 260 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g' = 500 LBS		1 'g'	

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE I - MECHANICAL JOINTS - CONFIGURATION E - DWG. NO. 7226-13021E-3B & 1B

SPECIMEN NO.	IE	122D01	122D02	122D03	122A01	122A02	122A03	122A04	122A05	122A06	122A07	122A08	122A09	122A10	112B01	112D02	112D03
ING. NO. 7226-1021E		1903	1907	1912	1901	1902	1904	1905	1906	1909	1910	1911	1913	1914	1902	1905	1908
TYPE OF TEST		← STATIC-TENSILE →		← STATIC-TENSILE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →	← PATIGURE →
R.T. RANGE °F		74	74	74	74/75	72/74	74	74	74/75	74/75	72/74	70/72	72	72/73	74	74	74
SECC. TEMP. RISE																	
DURING TEST °F		-	-	-	2	22	0	12	21	θ	4	14	20	18	-	-	-
STRAP MATERIAL					8-PLY BORON O ² WITH TWO TITANIUM SHIMS												
SPLICER PLATE MATERIAL					8-PLY BORON O ² WITH TWO TITANIUM SHIMS												
STRAP MATERIAL					TITANIUM 8A1-190-1V												
HOLE SEALANT					STM 40-111-B2												
SPR. LENGTH - IN.					18.0												
BORON STRAP WIDTH - IN.		1.002	1.003	.999	1.004	1.003	1.003	1.002	1.003	1.005	1.005	1.004	.999	.995	.999	.999	
T.L. STRAP WIDTH - IN.		.995	.999	1.001	1.005	.998	1.000	.998	.995	1.001	.999	.999	1.001	1.000	.995	1.001	1.000
SPLICER PLATE WIDTH - IN.		.927	.927	.994	1.004	.999	1.004	.998	.994	1.002	.999	.998	.998	1.001	1.001	1.000	.998
BORON STRAP THICK. - IN.		.046	.045	.045	.045	.046	.045	.043	.045	.045	.045	.045	.045	.045	.047	.047	.048
UNSTRETCHED SECT. THICK IN.		.082	.091	.089	.088	.088	.088	.086	.089	.090	.090	.091	.091	.091	.096	.095	.094
T.L. STRAP THICK. - IN.		.127	.127	.128	.127	.126	.127	.126	.125	.128	.127	.133	.127	.124	.127	.128	.125
SPLICER PLATE THICK. IN.		.037	.034	.035	.037	.037	.037	.037	.037	.039	.035	.037	.036	.038	.034	.034	.035
FASTENER HOLE DIA. IN.																	
PREPARED BY																	
JOINT ULTIMATE		.0716	.0725	.0748	.0719	.0717	.0717	.0700	.0725	.0735	.0735	.0741	.0738	.0734	.0779	.0770	.0762
LOAD - POUNDS		3920	2920	3080											2990	3030	3040
STRESS RATIO (R)								R = +0.30									
MAX. LOAD POUNDS					2150	2140	1800	2090	1820	1760	1760	2210	1770	2220			
MINIMUM FORCE - LBS					30	30	25	30	25	24	24	30	24	30	38	39	40
CYCLIC RATE - CPM					1700	1700	1700	1800	1800	1800	1600	1700	1700	1680			
PATIENCE LIFE																	
CYCLES X 10 ⁻³					25	249	22	39	83	392	256	14	10	37			
JOINT SLIPPER																	
(LBS./IN WIDTH) 10 ⁻³		132	140	137											126	130	135
FAILURE LOCATION						V	V	V	V	V	V	V	V	V	V	V	V
AND FAILURE MODE																	

PHASE I - MECHANICAL JOINTS - CONFIGURATION E - LMG. NO. 7226-13021E-5A & 1B

SPECIMEN NO.	TEST	211D01	211D02	211A01	211A02	211A03	211A04	211A05	211B01	211B02	211B03	211B04	211B05	211B06	211B07	211B08	211B09
LMG. NO. 7226-13021E		5A01	5A14	5A03	5A05	5A12	5A04	5A11	5A02	5A06	5A09	5A10	5A13	5A15	5A16	5A17	5A18
TYPE OF TEST		72	72	72/77	72/77	72/77	72/77	72/76	66/67	70/79	72/74	70/72	70/72	70/72	74/78	74/78	72/73
R. T. RANGE °																	
SPEC. TEMP. RISE																	
LOADING TEST °																	
STRAP MATERIAL																	
SPLICE PLATE MATERIAL																	
STRAP MATERIAL																	
JOINT SEALANT																	
SPEC. LENGTH - IN.																	
BORON STRAP WIDTH - IN.																	
TI. STRAP WIDTH - IN.																	
SPLICE PLATE WIDTH - IN.																	
BORON STRAP THICK - IN.																	
SHIMMED SECT. THICK IN.																	
TI. STRAP THICK - IN.																	
SPLICE PLATE THICK IN.																	
FASTENER HOLE DIA. IN.																	
SHIMMED BORON NET																	
SECTION AREA - IN ²																	
JOINT ULTIMATE																	
LOAD - POUNDS																	
STRESS RATIO (R)																	
MAX. LOAD POUNDS																	
MAX. LOAD POUNDS/IN ²																	
CYCLE RATE - CPM																	
FATIGUE LIFE																	
CYCLES X 10 ⁻³																	
JOINT STIFFNESS																	
(LBS/IN/IN WIDTH) 10 ⁻³																	
FAILURE LOCATION																	
AND FAILURE MODE																	

(1) = No failure, test discontinued.

PHASE 1 - MECHANICAL JOINTS - CONFIGURATION E - Dwg. No. 7226-13021E-7A, 9A

SPECIMEN NO. IS	311D01	311D02	311D03	311A01	311A02	311A03	311A04	311A05	321D01	321D02	321D03	321A01	321A02	321A03	321A04	321A05	321A06
DWG. NO. 7226-13021E	7A02	7A05	7A08	7A01	7A03	7A06	7A07	7A09	9A02	9A05	9A08	9A01	9A04	9A06	9A07	9A09	9A03
TYPE OF TEST	7A	7A	7A	7A/77	71/73	70/76	76/81	74/76	74	74	74	74/78	71/81	-	70/72	70/72	76/78
R.T. BARRIER	7A	7A	7A	7A/77	71/73	70/76	76/81	74/76	74	74	74	74/78	71/81	-	70/72	70/72	76/78
SPRG. TEMP. RISE	-	-	-	1	10	20	14	9	-	-	-	0	5	-	7	4	0
DURING TEST OF	-	-	-	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°	8-PLY BORON 0°/45°
STRAP MATERIAL	-	-	-	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V
STRUT PLATE MATERIAL	-	-	-	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V	TITANIUM 8A1-1M-1V
JOINT SEALANT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPRG. LENGTH - IN.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
BORON STRAP WIDTH - IN.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
T.L. STRAP WIDTH - IN.	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SPRICE PLATE WIDTH IN	.997	.993	.993	.996	.994	.994	.997	.998	.993	.993	.993	.997	.993	.993	.994	.994	.994
BORON STRAP THICK - IN	.046	.046	.047	.046	.046	.047	.047	.047	.044	.044	.045	.045	.045	.045	.045	.044	.046
SHIMMED SECTION THICK	.093	.093	.093	.094	.091	.093	.093	.093	.066	.064	.066	.066	.066	.066	.066	.066	.066
T.L. STRAP THICK - IN	.128	.127	.126	.126	.127	.127	.127	.127	.126	.127	.128	.127	.127	.125	.126	.126	.127
SPRICE PLATE THICK IN	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126	.126
PARTIAL ROLL DIA. IN.	.0753	.0753	.0753	.0762	.0737	.0753	.0753	.0754	.0536	.0521	.0535	.0537	.0537	.0538	.0536	.0534	.0537
SECTION AREA - IN. 2	.0753	.0753	.0753	.0762	.0737	.0753	.0753	.0754	.0536	.0521	.0535	.0537	.0537	.0538	.0536	.0534	.0537
JOINT UTMATE LOAD - POUNDS	3300	2020	2890	1820	1180	1280	1280	1280	1410	1520	1550	910	910	910	1020	1070	1070
STRESS RATIO (R)				1820	1180	1280	1280	1280	1410	1520	1550	910	910	910	1020	1070	1070
MAX. LOAD POUNDS				1820	1180	1280	1280	1280	1410	1520	1550	910	910	910	1020	1070	1070
SHIMMED BORON NET				16	16	17	17	17	26	29	29	17	17	17	19	20	20
SECTION STRESS KSI	45	39	38	1550	1800	1800	1675	1550	1550	1550	1550	1700	1725	1550	1550	1500	1525
CYCLE RATE - GPM				1550	1800	1800	1675	1550	1550	1550	1550	1700	1725	1550	1550	1500	1525
FATIGUE LIFE				795	10450	14840	3310	752				10450	16460	(2)	1688	733	75
CYCLES X 10 ⁻³				795	10450	14840	3310	752				10450	16460	(2)	1688	733	75
JOINT STRESS				196	194	178			151	157	195						
(180°/IN WIDTH) 10 ⁻³				196	194	178			151	157	195						
FAILURE LOCATION AND																	
FAILURE MODE	S	S	S	Z	(1)	(1)	Z	Z	X	X	X	(1)	(1)	(2)	Z	Z	Z
NOTES: (1) No failure, test discontinued.																	
(2) Specimen failed on loading.																	

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. 1752
PAGE 4

PHASE I - MECHANICAL JOINTS CONFIGURATION E - Dwg. NO. 7226-13021E-11A & 13A

SPECIMEN NO.	1E	411D01	411D02	411D03	411A01	411A02	411A03	411A04	411A05	421D01	421D02	421D03	421A01	421A02	421A03	421A04	421A05
DWG. NO. 7226-13021E		11A02	11A05	11A08	11A01	11A03	11A06	11A09	13A02	13A03	13A06	13A09	13A01	13A03	13A04	13A06	13A09
TYPE OF TEST	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
R.T. RANGE OF	74	74	74	74	74	74	72	72	74	74	74	74	74	72	72	72/76	72
STRESS, TEMP. RISE																	
DURING TEST OF																	
STRAP MATERIAL	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
TRICE PLATE MATERIAL	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
STRAP MATERIAL	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
JOINT SEALANT	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
LENGTH - IN.	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
BORON STRAP WIDTH - IN.	1.063	1.005	1.002	1.005	1.007	1.004	1.005	1.007	1.004	1.004	1.006	1.005	1.007	1.004	1.008	1.023	1.005
PL. STRAP WIDTH - IN.	1.000	1.003	1.002	1.005	1.003	1.003	1.001	1.000	1.000	1.000	1.002	1.001	1.000	1.001	1.001	1.000	1.000
SPACER PLATE WIDTH - IN.	1.000	1.002	1.002	1.002	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
BORON STRAP THICK - IN.	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005	1.005
CHUNKED SECTION THICK - IN.	1.170	1.170	1.170	1.171	1.170	1.170	1.170	1.168	1.174	1.174	1.175	1.175	1.175	1.175	1.175	1.175	1.175
PL. STRAP THICK - IN.	1.239	1.240	1.244	1.242	1.243	1.241	1.239	1.243	1.243	1.243	1.239	1.243	1.243	1.241	1.242	1.242	1.239
SPACER PLATE THICK - IN.	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
FASTENER HOLE DIA. IN.	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
SHIMMED BORON NET	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
SECTION AREA - IN ²	1.139	1.139	1.139	1.140	1.139	1.139	1.139	1.139	1.139	1.101	1.102	1.100	1.101	1.100	1.101	1.101	1.100
JOINT UTMATE	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
LOADS - POUNDS	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250	6250
STRESS RATIO (R)	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
MAX. LOAD POUNDS	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
SHIMMED BORON NET	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
SECTION STRESS - KSI	45	45	44	22	22	22	22	22	28	28	26	24	22	22	22	22	22
CYCLE RATE - G/M	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
FATIGUE LIFE	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
CYCLE X 10 ⁻³	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
JOINT STRESS	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
(LBS./IN. WIDTH) 10 ⁻³	242	244	232	→	→	→	→	→	→	→	→	→	→	→	→	→	→
FAILURE LOCATION AND	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
FAILURE MODE	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→
R = Fastener shear failure on boron side of joint.	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→

PHASE I - MECHANICAL JOINTS CONFIGURATION E - DWG. NO. 7226-15021E-15A & 17A

DESIGNER NO.	1E	711001	711002	711003	711A01	711A02	711A03	711A04	711A05	711A06	711A07	711A08	711A09	711A10	711A11	711A12	711A13	711A14	711A15	711A16	711A17	711A18	711A19	711A20	711A21	711A22	711A23	711A24	711A25	711A26	711A27	711A28	711A29	711A30	711A31	711A32	711A33	711A34	711A35	711A36	711A37	711A38	711A39	711A40	711A41	711A42	711A43	711A44	711A45	711A46	711A47	711A48	711A49	711A50	711A51	711A52	711A53	711A54	711A55	711A56	711A57	711A58	711A59	711A60	711A61	711A62	711A63	711A64	711A65	711A66	711A67	711A68	711A69	711A70	711A71	711A72	711A73	711A74	711A75	711A76	711A77	711A78	711A79	711A80	711A81	711A82	711A83	711A84	711A85	711A86	711A87	711A88	711A89	711A90	711A91	711A92	711A93	711A94	711A95	711A96	711A97	711A98	711A99	711A100	711A101	711A102	711A103	711A104	711A105	711A106	711A107	711A108	711A109	711A110	711A111	711A112	711A113	711A114	711A115	711A116	711A117	711A118	711A119	711A120	711A121	711A122	711A123	711A124	711A125	711A126	711A127	711A128	711A129	711A130	711A131	711A132	711A133	711A134	711A135	711A136	711A137	711A138	711A139	711A140	711A141	711A142	711A143	711A144	711A145	711A146	711A147	711A148	711A149	711A150	711A151	711A152	711A153	711A154	711A155	711A156	711A157	711A158	711A159	711A160	711A161	711A162	711A163	711A164	711A165	711A166	711A167	711A168	711A169	711A170	711A171	711A172	711A173	711A174	711A175	711A176	711A177	711A178	711A179	711A180	711A181	711A182	711A183	711A184	711A185	711A186	711A187	711A188	711A189	711A190	711A191	711A192	711A193	711A194	711A195	711A196	711A197	711A198	711A199	711A200	711A201	711A202	711A203	711A204	711A205	711A206	711A207	711A208	711A209	711A210	711A211	711A212	711A213	711A214	711A215	711A216	711A217	711A218	711A219	711A220	711A221	711A222	711A223	711A224	711A225	711A226	711A227	711A228	711A229	711A230	711A231	711A232	711A233	711A234	711A235	711A236	711A237	711A238	711A239	711A240	711A241	711A242	711A243	711A244	711A245	711A246	711A247	711A248	711A249	711A250	711A251	711A252	711A253	711A254	711A255	711A256	711A257	711A258	711A259	711A260	711A261	711A262	711A263	711A264	711A265	711A266	711A267	711A268	711A269	711A270	711A271	711A272	711A273	711A274	711A275	711A276	711A277	711A278	711A279	711A280	711A281	711A282	711A283	711A284	711A285	711A286	711A287	711A288	711A289	711A290	711A291	711A292	711A293	711A294	711A295	711A296	711A297	711A298	711A299	711A300	711A301	711A302	711A303	711A304	711A305	711A306	711A307	711A308	711A309	711A310	711A311	711A312	711A313	711A314	711A315	711A316	711A317	711A318	711A319	711A320	711A321	711A322	711A323	711A324	711A325	711A326	711A327	711A328	711A329	711A330	711A331	711A332	711A333	711A334	711A335	711A336	711A337	711A338	711A339	711A340	711A341	711A342	711A343	711A344	711A345	711A346	711A347	711A348	711A349	711A350	711A351	711A352	711A353	711A354	711A355	711A356	711A357	711A358	711A359	711A360	711A361	711A362	711A363	711A364	711A365	711A366	711A367	711A368	711A369	711A370	711A371	711A372	711A373	711A374	711A375	711A376	711A377	711A378	711A379	711A380	711A381	711A382	711A383	711A384	711A385	711A386	711A387	711A388	711A389	711A390	711A391	711A392	711A393	711A394	711A395	711A396	711A397	711A398	711A399	711A400	711A401	711A402	711A403	711A404	711A405	711A406	711A407	711A408	711A409	711A410	711A411	711A412	711A413	711A414	711A415	711A416	711A417	711A418	711A419	711A420	711A421	711A422	711A423	711A424	711A425	711A426	711A427	711A428	711A429	711A430	711A431	711A432	711A433	711A434	711A435	711A436	711A437	711A438	711A439	711A440	711A441	711A442	711A443	711A444	711A445	711A446	711A447	711A448	711A449	711A450	711A451	711A452	711A453	711A454	711A455	711A456	711A457	711A458	711A459	711A460	711A461	711A462	711A463	711A464	711A465	711A466	711A467	711A468	711A469	711A470	711A471	711A472	711A473	711A474	711A475	711A476	711A477	711A478	711A479	711A480	711A481	711A482	711A483	711A484	711A485	711A486	711A487	711A488	711A489	711A490	711A491	711A492	711A493	711A494	711A495	711A496	711A497	711A498	711A499	711A500	711A501	711A502	711A503	711A504	711A505	711A506	711A507	711A508	711A509	711A510	711A511	711A512	711A513	711A514	711A515	711A516	711A517	711A518	711A519	711A520	711A521	711A522	711A523	711A524	711A525	711A526	711A527	711A528	711A529	711A530	711A531	711A532	711A533	711A534	711A535	711A536	711A537	711A538	711A539	711A540	711A541	711A542	711A543	711A544	711A545	711A546	711A547	711A548	711A549	711A550	711A551	711A552	711A553	711A554	711A555	711A556	711A557	711A558	711A559	711A560	711A561	711A562	711A563	711A564	711A565	711A566	711A567	711A568	711A569	711A570	711A571	711A572	711A573	711A574	711A575	711A576	711A577	711A578	711A579	711A580	711A581	711A582	711A583	711A584	711A585	711A586	711A587	711A588	711A589	711A590	711A591	711A592	711A593	711A594	711A595	711A596	711A597	711A598	711A599	711A600	711A601	711A602	711A603	711A604	711A605	711A606	711A607	711A608	711A609	711A610	711A611	711A612	711A613	711A614	711A615	711A616	711A617	711A618	711A619	711A620	711A621	711A622	711A623	711A624	711A625	711A626	711A627	711A628	711A629	711A630	711A631	711A632	711A633	711A634	711A635	711A636	711A637	711A638	711A639	711A640	711A641	711A642	711A643	711A644	711A645	711A646	711A647	711A648	711A649	711A650	711A651	711A652	711A653	711A654	711A655	711A656	711A657	711A658	711A659	711A660	711A661	711A662	711A663	711A664	711A665	711A666	711A667	711A668	711A669	711A670	711A671	711A672	711A673	711A674	711A675	711A676	711A677	711A678	711A679	711A680	711A681	711A682	711A683	711A684	711A685	711A686	711A687	711A688	711A689	711A690	711A691	711A692	711A693	711A694	711A695	711A696	711A697	711A698	711A699	711A700	711A701	711A702	711A703	711A704	711A705	711A706	711A707	711A708	711A709	711A710	711A711	711A712	711A713	711A714	711A715	711A716	711A717	711A718	711A719	711A720	711A721	711A722	711A723	711A724	711A725	711A726	711A727	711A728	711A729	711A730	711A731	711A732	711A733	711A734	711A735	711A736	711A737	711A738	711A739	711A740	711A741	711A742	711A743	711A744	711A745	711A746	711A747	711A748	711A749	711A750	711A751	711A752	711A753	711A754	711A755	711A756	711A757	711A758	711A759	711A760	711A761	711A762	711A763	711A764	711A765	711A766	711A767	711A768	711A769	711A770	711A771	711A772	711A773	711A774	711A775	711A776	711A777	711A778	711A779	711A780	711A781	711A782	711A783	711A784	711A785	711A786	711A787	711A788	711A789	711A790	711A791	711A792	711A793	711A794	711A795	711A796	711A797	711A798	711A799	711A800	711A801	711A802	711A803	711A804	711A805	711A806	711A807	711A808	711A809	711A810	711A811	711A812	711A813	711A814	711A815	711A816	711A817	711A818	711A819	711A820	711A821	711A822	711A823	711A824	711A825	711A826	711A827	711A828	711A829	711A830	711A831	711A832	711A833	711A834	711A835	711A836	711A837	711A838	711A839	711A840	711A841	711A842	711A843	711A844	711A845	711A846	711A847	711A848	711A849	711A850	711A851	711A852	711A853	711A854	711A855	711A856	711A857	711A858	711A859	711A860	711A861	711A862	711A863	711A864	711A865	711A866	711A867	711A868	711A869	711A870	711A871	711A872	711A873	711A874	711A875	711A876	711A877	711A878	711A879	711A880	711A881	711A882	711A883	711A884	711A885	711A886	711A887	711A888	711A889	711A890	711A891	711A892	711A893	711A894	711A895	711A896	711A897	711A898	711A899	711A900	711A901	711A902	711A903	711A904	711A905	711A906	711A907	711A908	711A909	711A910	711A911	711A912	711A913	711A914	711A915	711A916	711A917	711A918	711A919	711A920	711A921	711A922	711A923	711A924	711A925	711A926	711A927	711A928	711A929	711A930	711A931	711A932	711A933	711A934	711A935	711A936	711A937	711A938	711A939	711A940	711A941	711A942	711A943	711A944	711A945	711A946	711A947	711A948	711A949	711A950	711A951	711A952	711A953	711A954	711A955	711A956	711A957	711A958	711A959	711A960	711A961	711A962	711A963	711A964	711A965	711A966	711A967	711A968	711A969	711A970	711A971	711A972	711A973	711A974	711A975	711A976	711A977	711A978	711A979	711A980	711A981	711A982	711A983	711A984	711A985	711A986	711A987	711A988	711A989	711A990	711A991	711A992	711A993	711A994	711A995	711A996	711A997	711A998	711A999	711A1000	711A1001	711A1002	711A1003	711A1004	711A1005	711A1006	711A1007	711A1008	711A1009	711A1010	711A1011	711A1012	711A1013	711A1014	711A1015	711A1016	711A1017	711A1018	711A1019	711A1020	711A1021	711A1022	711A1023	711A1024	711A1025	711A1026	711A1027	711A1028	711A1029	711A1030	711A1031	711A1032	711A1033
--------------	----	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

Z = Net Section Tensile Failure
Y = Net Section Tensile/Tear Out
X = Shear Failure From Hole.
(A) = No Failure, Test Discontinued

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

TABLE I - MECHANICAL JOINTS CONFIGURATION 2 - DMO, NO. 7226-1302E-19A

SYMBOL NO. 1E	731001	731002	731003	731004	731005	731006	731007
DMO. NO. 7226-1302E	19A08	19A05	19A08	19A01	19A03	19A06	19A07
TYPE OF JOINT	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC
TEST NAME	78	78	78	80	77	76	80
TEST TEMP. DEG							
TEST SPEED							
COUPLER MATERIAL	8-PIN BRONZE C 45° WITH TWO 24° BORE JOINTS						
SYMBOLS DIMENSIONS							
JOINT - IN.					9.0		
AVG. VIBER - IN.	1.002	1.003	1.001	1.006	1.002	1.003	1.003
COUPLER THICK. - IN.	.0445	.0441	.0434	.0438	.0443	.0442	.0445
BEARING SECTION							
THICK. - IN.	.0651	.0638	.0643	.0638	.0655	.0643	.0643
PIE HOLE DIAMETER - IN.	.1856	.1907	.1896	.1891	.1896	.1907	.1874
PIE HOLE DISTANCE - IN.	.3764	.3803	.3785	.3766	.3729	.3760	.3753
PIE BEARING AREA - IN. ²	.0123	.0122	.0121	.0121	.0124	.0123	.0121
YIELD LOAD PART - LBS.	750	780	760				
YIELD STRESS PART - KSI	64.8	64.1	62.7				
ULT. STRESS PART - KSI							
STRESS RATIO (R)							
MAX. LOAD POUNDS				500	400	300	600
MAX. BEARING STRESS - KSI				41.5	32.2	24.5	49.8
CYCLE RATE - CPM				1500	1500	1550	1550
BEARING LIFE							
CYCLES X 10 ⁻³				39	125	3303	6
FAILING MODE	X	X	X	X	X	X	X
NOTE: (1) Yield Unobtainable From Load - Deformation Curve.							

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PHASE II - MECHANICAL JOINTS - CONFIGURATION E - DNG. NO. 7226-13021TR-1A

[illegible]

PHASE II - MECHANICAL JOINTS, CONFIGURATION E - DWG. NO. 7226-1302111-1A

SPECIMEN NO.	11E	611P01	611P02	611P03	611P04	611P05
DWG. NO.	7226-19021IP	1A02	1A06	1A11	1A17	1A22
TYPE OF TEST						
R. T. RAGE OF	71	70/72	72	72/73	70	
SPEC. TEMP. RISE						
BENDING TEST OF	4	4	5	5	5	1
STRAP MATERIAL	-B-PH BORON, 0°/245°	2	TITANIUM STRIPS			
SPLICER PLATE MATERIAL	TITANIUM GAL-180-IV					
JOINT SEALANT	TITANIUM GAL-180-IV					
SPECIMEN LENGTH - IN.	SYM /2-112-912					
BORON STRAP WIDTH - IN.	1.961	1.966	1.971	1.966	1.967	
TI. STRAP WIDTH - IN.	1.960	1.965	1.969	1.965	1.966	
SPLICER PLATE WIDTH - IN.	1.960	1.966	1.970	1.966	1.967	
BORON STRAP THICK - IN.	.044	.043	.044	.045	.044	
SPLICER SECT. THICK IN.	.084	.086	.090	.090	.087	
TI. STRAP THICK - IN.	.128	.128	.130	.131	.130	
SPLICER PLATE THICK - IN.			0.125			
FASTENER HOLE DIA. - IN.			0.188			
FASTENER HOLE DIA. - IN²	.133	.137	.144	.143	.138	
ZAITUNE BLOCK NO.	5	12	9	9	11	
FATIGUE LOAD NO.	10	10	10	10	10	
FATIGUE LOAD IN "G"	0	0	0	0	0	
NO. OF CYCLES IN LAST						
LOAD LEVEL	44	25	1	25	1	
TOTAL NO. OF CYCLES	19565	71795	58668	58692	84767	
FATIGUE LOCATION AND						
FAILURE MODE	S	T	T	T	S	

PHASE II - MECHANICAL JOINTS, CONFIGURATION E - DWG. NO. 7226-1302112-1A

SPECIMEN NO.	118	611001	611002	611003	611004	611005
ENG. NO. 7226-130211E	1A03	1A09	1A13	1A19	1A26	
TYPE OF TEST	→ PASTOR-RELICTIC SPECTROM					
R. T. RANGE °	71/72	71/74	71/72	72	73/74	
TEMP. SIZE	2	1	2	1	2	
NUMBER TEST °	→ 8-24 BORON 0/445.2 TITANIUM SHIMS					
STRAP MATERIAL	→ TITANIUM 8AL-180-1Y					
SPRICE PLATE MATERIAL	→ TITANIUM 8AL-180-1Y					
STRAP MATERIAL	→ TITANIUM 8AL-180-1Y					
LOWER STRAP	→ STR 40-111.812					
LENGTH LENGTH - IN.	→ 10.0					
STRAP WIDTH - IN.	1.966	1.967	1.963	1.964	1.971	
PL. STRAP WIDTH - IN.	1.966	1.965	1.962	1.963	1.970	
SPRICE PLATE WIDTH IN.	1.967	1.968	1.965	1.964	1.972	
STRAP THICK - IN.	.043	.044	.044	.044	.044	
STRAP THICK IN.	.084	.089	.090	.090	.087	
PL. STRAP THICK - IN.	.131	.129	.128	.129	.131	
SPRICE PLATE THICK - IN.	→ 0.125					
PASTOR ROPE DIA. IN.	→ 0.188					
STRAP THICK - IN.	.137	.142	.143	.143	.139	
SECTION AREA - IN ²	→					
PASTOR OCCURRED	→					
NUMBER MISS. TYPE NO.	2	4	4	4	4	
TEST SEQUENCE NO.	→					
(TABLES 31 (1))	1894	810	1703	810	1890	
ETOLIC SEQUENCE NO.	→					
TABLES (27-31 (1))	48	21	21	21	21	
LOAD LEVEL IN 'g's	5	8	8	8	8	
ACTUAL FAILING	→					
LOAD - POUNDS	3600	5800	5820	5800	5620	
FAILURE LOCATION	→					
A FAILURE NOTE	T	S	T	S	T	
NOTES:	① Table 10 477 L-78-7144					
	② This load level was used for testing convenience only.					

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. 171-5
PAGE 1

PHASE I - MECHANICAL JOINTS - CONFIGURATION P - DNG. NO. 7226-13021P-1A

SPECIMEN NO. & IP	111D01	111D02	111D03	111A01	111A02	111A03	111A04	111A05	111A06	111A07	111A08	111A09	111A10	111A11
DNG. NO. 7226-13021P	1A01	1A08	1A12	1A01	1A02	1A04	1A05	1A06	1A09	1A10	1A11	1A13	1A14	1A07
TYPE OF TEST	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC	STATIC
R. P. RANGE °	75	77	76	78	70/73	69/70	70	71	70	70/71	69/70	70	70	70/73
SPC. TEMP. RISE	-	-	-	-	10	6	6	6	10	9	6	6	6	6
DORIEL TEST °	-	-	-	-	10	6	6	6	10	9	6	6	6	6
STRAP MATERIAL	9-PAY BORO. 0°/45° + TWO TITANIUM STRIPS													
TIT. MATERIAL	ALUMINUM 7075-T6													
JOINT SEALANT	STH 40-112-912													
SPECIMEN DIMENSIONS														
LENGTH - IN.					18.0									
BORO STRAP WIDTH - IN.														
TIT. PLATE WIDTH - IN.	1.001	1.005	1.003	1.002	1.004	1.002	1.003	1.004	1.004	1.002	1.003	1.002	1.003	1.002
TIT. STRIP WIDTH - IN.														
BORO STRAP THICK - IN.	.043	.041	.044	.043	.043	.043	.043	.044	.044	.043	.043	.043	.043	.044
SHIMMED SECT. THICK IN.	.084	.085	.084	.084	.084	.084	.084	.084	.085	.085	.085	.084	.084	.084
TIT. PLATE THICK - IN.					0.127									
TIT. STRIP THICK - IN.	.082	.082	.083	.083	.083	.083	.083	.083	.083	.083	.082	.082	.084	.082
FASTENER HOLE DIA. IN.						0.188								
MINIMUM BORO SECTION AREA - IN ²	.0619	.0694	.0685	.0684	.0685	.0684	.0685	.0685	.0594	.0692	.0693	.0684	.0685	.0684
STATIC AXIAL LOAD AT FAILURE - POUNDS	5780	4490	4800											
STATIC SIDE LOAD AT FAILURE - POUNDS	102	250	640											
STRESS RATIO (R)								R = 20.10						
MAXIMUM DYNAMIC AXIAL LOAD - POUNDS				3000	2740	2740	2740	2740	2780	2770	2770	2740	2740	2740
SECT. STRESS - PSI				44	40	40	40	40	40	40	40	40	40	40
DYNAMIC SIDE LOAD														
MAXIMUM - POUNDS				105	105	105	265	105	265	265	105	265	265	105
MINIMUM - POUNDS				95	95	95	235	95	235	235	95	235	235	95
CYCLE RATE - CPM				1400	1550	1550	1675	1550	1650	1675	1725	1675	1675	1675
PATIENCE LIFE														
CYCLES X 10 ⁻³				18	355	320	19	40	17	25	180	18	17	253
FAILURE MODE	S	S	T	T	T	S	T	S	T	T	T	T	T	T

[illegible]

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. 1
MODEL 1
PAGE 1

HONDED JOINT TESTS - GRAPHITE EPOXY ADHERENDS - CONFIGURATION A

Specimen No.	E1D01	E1D02	E1D03	E1A01	E1A02	E1A03	E1A04	E1A05	E1A06	E1A07	E1A08	E1A09	E1A10
D407226-13021A-0	3A	76	12A	1A	2A	4A	5A	6A	9A	10A	11A	13A	14A
Type of Test	Static	Static						Fatigue					
H.T. Range by	76	76	76	76	73	76	70	70	72	76	70	72	72
Spec. Temp. Rise													
During Test				2	4	0	7	1	5	0	7	-	6
Adherend Matl.				Graphite Epoxy - 3 Ply 0°/± 45°									
Splice Plate Matl.				Ti-6Al-4V									
Alcohol				80% - 90% Wt.									
Specimen Dimensions													
Length				Nominally 19.0 In.									
Width	1.004	1.004	1.010	1.003	1.004	1.005	1.004	1.004	1.003	1.006	1.012	1.016	1.017
Overlap Length													
Left Side	.74	.73	.74	.74	.74	.74	.74	.74	.74	.74	.75	.75	.75
Right Side	.75	.74	.74	.75	.75	.75	.74	.74	.74	.74	.73	.72	.73
Bondline Thick. (Mils)	4.0	4.5	3.5	3.0	4.0	3.0	4.0	5.0	4.0	4.0	5.0	4.0	4.0
Failure Side	L	L	H	R	R	L	R	R	R	R	R	L	R
Failure Area - In.²	.743	.733	.747	.742	.743	.744	.743	.743	.742	.744	.739	.732	.742
Ultimate Load													
Pcu - Pounds	2840	3060	2920										
Ultimate Shear													
Pcu - Stress	3800	4200	3800										
Stress Ratio (R)						H = 0.1							
Max. Load Pounds				1480	1940	1490	1040	1410	1040	1490	1030	1390	1040
Max. Shear Stress				2000	1400	2000	1400	1900	1400	2000	1400	1900	1400
Cycle Rate - JPM				1800	1750	1700	1750	1800	1600	1700	1650	1800	1750
Fatigue Life													
Cycles X 10⁻³				6	1623	3	1001	5	831	9	233	3	1002
Joint Stiffness													
(lb./in. width) 10⁻³	3.4	3.1	2.86										

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

BONDED JOINT TESTS - GLASS EPOXY ADHESIVS - CONFIGURATION A

Specimen No.	E2A01	E2A02	E2A03	E2A04	E2A05	E2A06	E2A07	E2A08	E2A09	E2A10
Q40, F7226-13021A-70	1A	2A	3A	4A	5A	6A	7A	8A	9A	10A
Type of Test	Static	Static	Static	Static	Static	Static	Static	Static	Static	Static
R. T. Range Or	75	73	76	72	74	73	76	72	74	72
Spec. Temp. Rise										
Bonding Test	3	9	-	15	13	10	-	2	15	1
Adherend Matl.	S-Glass, Epoxy - 8 Ply 0°/±45°									
Splice Plate Matl.	T1-6-4									
Adhesive	EAP601-045 Wt.									
Specimen Dimensions	Nominally 18.0 In.									
Length	1.009	1.005	1.008	1.005	1.006	1.007	1.007	1.007	1.007	1.007
Width										
Overlap Length										
Left Side	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
Right Side	.73	.73	.73	.73	.74	.74	.74	.75	.75	.75
Bondline Thick. (Mils)	3.5	3.5	3.2	3.7	4.0	4.7	3.5	3.5	4.5	4.2
Failure Side	L	L	R	R	R	R	R	R	R	R
Failure Area - In.²	.737	.734	.736	.734	.744	.744	.745	.743	.757	.750
Ultimate Load										
Fat - Pounds		3330					3360		3650	
Ultimate Shear										
Fat - Stress		4500					4500		4800	
Stress Ratio (R)	0.1				0.1		0.1			0.1
Max. Load Pounds	1470	1030	-	1470	1490	1490	1030	1040	1470	1050
Max. Shear Stress	2000	1400	-	2000	1400	2000	1400	1400	2000	1400
Cycle Rate - CPM	1550	1525	-	1600	1550	1600	-	1425	1550	1600
Fatigue Life										
Cycles X 10 ⁻³	5	230	-	52	526	75	-	1250	143	19
Joint Stiffness										
(Lb./In. Width) 10 ⁻³		213					211			

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

FAILURE MODES - BONDED JOINTS

ADHESIVE EVALUATION TESTS				PHASE I - CONFIGURATION A - BASELINE DATA			
SPECIMEN NO.	AM	C	OF FAILURE AREA	SPECIMEN NO.	AM	AB	C
V1C01	30	70		111A16	70	20	10
V1C02	40	60		111A17	5		95
V1C03	40	60		111A18	(50% Adherend)	50	20
V1C04	30	70		111A21			90 10
V1C05	40	60		111A22	30		70
V1A01	10	90		111B01	10	Failed on loading	90
V1A02	10	90		111B02	Adherend Failure		50
V1A03	20	80		111B03	50		90 10
V1A04	30	70		111B04			
V1A05	40	60		111B05			
V1A06	50	50		111B06			
V1A07	60	40		111B07	40	10	50
V1A08	70	30		111B08	5		90 5
V1A09	80	20		111B09	60		40
V1A10	90	10		111B10	60		40
V1A11	100	0		111B11	90	10	
V1A12	100	0		111B12	30	40	10 20
V1A13	100	0		111B25	30	40	30
V1A14	100	0		111B26	50		50
V1A15	100	0		111B27			90 10
V1A16	100	0		111B28	5		85 10
V1A17	100	0		111B29	90		10
V1A18	100	0		111B30	10	10	80
V1A19	100	0		111B31	10		85 5
V1A20	100	0		111B32	10	10	80
V1A21	100	0		111C01	Failure not recorded		
V1A22	100	0		111C02	5		55 40
V1A23	100	0		111C03	No failure		80
V1A24	100	0		111C04	20		
V1A25	100	0		111C05	No failure		
V1A26	100	0		111C06	Failure not recorded		
V1A27	100	0		111C07	Failure not recorded		
V1A28	100	0		111C08	60	40	
V1A29	100	0		111C09	30	40	30
V1A30	100	0		111C10	100		

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO.
TABLE VIB
PAGE 2

FAILURE MODES - BONDED JOINTS									
PHASE I - CONFIGURATION A - BASELINE DATA					PHASE I - CONFIGURATION A - DEGRADATION				
TYPE AND PERCENTAGE OF FAILURE AREA					TYPE AND PERCENTAGE OF FAILURE AREA				
NO.	A ₁	A ₂	C	I ₁	NO.	A ₁	A ₂	C	I ₁
511A01	10	90		100	511A05	Adherend Failure			
511A02					511A06	Adherend Failure			
511A03					511A07	Adherend Failure			
511A04					511A08	Adherend Failure			
511A05					511A09	Adherend Failure			
511A06					511A10	Adherend Failure			
511A07					511A11	Adherend Failure			
511A08					511A12	Adherend Failure			
511A09					511A13	Adherend Failure			
511A10					511A14	Adherend Failure			
511A11					511A15	Adherend Failure			
511A12					511A16	Adherend Failure			
511A13					511A17	Adherend Failure			
511A14					511A18	Adherend Failure			
511A15					511A19	Adherend Failure			
511A16					511A20	Adherend Failure			
511A17					511A21	Adherend Failure			
511A18					511A22	Adherend Failure			
511A19					511A23	Adherend Failure			
511A20					511A24	Adherend Failure			
511A21					511A25	Adherend Failure			
511A22					511A26	Adherend Failure			
511A23					511A27	Adherend Failure			
511A24					511A28	Adherend Failure			
511A25					511A29	Adherend Failure			
511A26					511A30	Adherend Failure			
511A27					511A31	Adherend Failure			
511A28					511A32	Adherend Failure			
511A29					511A33	Adherend Failure			
511A30					511A34	Adherend Failure			
511A31					511A35	Adherend Failure			
511A32					511A36	Adherend Failure			
511A33					511A37	Adherend Failure			
511A34					511A38	Adherend Failure			
511A35					511A39	Adherend Failure			
511A36					511A40	Adherend Failure			
511A37					511A41	Adherend Failure			
511A38					511A42	Adherend Failure			
511A39					511A43	Adherend Failure			
511A40					511A44	Adherend Failure			
511A41					511A45	Adherend Failure			
511A42					511A46	Adherend Failure			
511A43					511A47	Adherend Failure			
511A44					511A48	Adherend Failure			
511A45					511A49	Adherend Failure			
511A46					511A50	Adherend Failure			
511A47					511A51	Adherend Failure			
511A48					511A52	Adherend Failure			
511A49					511A53	Adherend Failure			
511A50					511A54	Adherend Failure			
511A51					511A55	Adherend Failure			
511A52					511A56	Adherend Failure			
511A53					511A57	Adherend Failure			
511A54					511A58	Adherend Failure			
511A55					511A59	Adherend Failure			
511A56					511A60	Adherend Failure			
511A57					511A61	Adherend Failure			
511A58					511A62	Adherend Failure			
511A59					511A63	Adherend Failure			
511A60					511A64	Adherend Failure			
511A61					511A65	Adherend Failure			
511A62					511A66	Adherend Failure			
511A63					511A67	Adherend Failure			
511A64					511A68	Adherend Failure			
511A65					511A69	Adherend Failure			
511A66					511A70	Adherend Failure			
511A67					511A71	Adherend Failure			
511A68					511A72	Adherend Failure			
511A69					511A73	Adherend Failure			
511A70					511A74	Adherend Failure			
511A71					511A75	Adherend Failure			
511A72					511A76	Adherend Failure			
511A73					511A77	Adherend Failure			
511A74					511A78	Adherend Failure			
511A75					511A79	Adherend Failure			
511A76					511A80	Adherend Failure			
511A77					511A81	Adherend Failure			
511A78					511A82	Adherend Failure			
511A79					511A83	Adherend Failure			
511A80					511A84	Adherend Failure			
511A81					511A85	Adherend Failure			
511A82					511A86	Adherend Failure			
511A83					511A87	Adherend Failure			
511A84					511A88	Adherend Failure			
511A85					511A89	Adherend Failure			
511A86					511A90	Adherend Failure			
511A87					511A91	Adherend Failure			
511A88					511A92	Adherend Failure			
511A89					511A93	Adherend Failure			
511A90					511A94	Adherend Failure			
511A91					511A95	Adherend Failure			
511A92					511A96	Adherend Failure			
511A93					511A97	Adherend Failure			
511A94					511A98	Adherend Failure			
511A95					511A99	Adherend Failure			
511A96					511A100	Adherend Failure			

LOCHNEED-GEORGIA COMPANY
A DIVISION OF LOCHNEED AIRCRAFT CORPORATION

REPORT NO. **TABLE VII**
PAGE **3**

FAILURE MODES - BONDED JOINTS

PHASE I - CONFIGURATION A - BASELINE DATA										PHASE I - CONFIGURATION A - PLY STACKING EFFECTS									
SPECIMEN										SPECIMEN									
TYPE AND PERCENTAGE OF FAILURE AREA										TYPE AND PERCENTAGE OF FAILURE AREA									
NO.	A ₁	A ₂	A ₃	C	I ₁	I ₂	I ₃	I ₄	I ₅	NO.	A ₁	A ₂	A ₃	C	I ₁	I ₂	I ₃	I ₄	I ₅
IA11201					Adhered Failure					IA211 A13									100
112 D02					"					211 A14									100
112 D03					"					211 A15									100
112 D04					"					211 A16									100
112 A01					"	100				211 A17									100
112 A02					Splice Plate Failure					211 A18									100
112 A03					"	100				211 A19									100
112 A04					Splice Plate Failure					211 A20									94
112 A05					"	90				211 A21									100
112 A06					"	100				IA313 D01					20	80			
112 A07					Splice Plate Failure					313 D02					(Splice Plate)				100
112 A08					"	100				313 D03					"				100
112 A09					"	100				313 A01									100
112 A10					"	100				313 A02									100
PHASE I - CONFIGURATION A - PLY STACKING										PHASE I - CONFIGURATION A - LAP-LENGTH EFFECTS									
IA213 D01										313 A03									100
213 D02										313 A04									100
213 D03										313 A05				10					90
213 A01										313 A06									100
213 A02										313 A07									100
213 A03										312 D01					50	50			
213 A04										312 D02					50	50			
213 A05										312 D03					50	50			
213 A06										312 A01									100
213 A07										312 A02									100
213 A08										312 A03					Splice Plate Failure				
213 A09										312 A04									100
213 A10										312 A05					Splice Plate Failure				
211 D01				20															
211 D02				25															
211 D03																			
211 D04																			
211 D05																			
211 D06																			
211 A11				10															
211 A12																			

FAILURE MODES - BONDED JOINTS									
PHASE I - CONFIGURATION A - LAP LENGTH EFFECTS					PHASE I - CONFIGURATION A - LAP LENGTH EFFECTS				
SPECIMEN NO.	A ₁	A ₂	C	I ₁	SPECIMEN NO.	A ₁	A ₂	C	I ₁
1A911 D01	50			50	1A421 A15	10			20
911 D02	10			80	421 A16	10			80
911 D03	30		20	30	421 A17	40			40
911 D04	10		10	80	421 A18	10			70
911 D05	40			60	421 A19	10			80
911 D06	10			20	421 A20	10			40
911 D07	20			80	PHASE I - CONFIGURATION B - BASELINE				
911 D08	20			80	111 D01				Adherend Failure
911 D09			Adherend Failure		111 D03				
911 D10			"		111 D05				
PHASE I - CONFIGURATION A - THICKNESS EFFECTS					111 D07				
1A411 D01	5			95	111 A01	50		30	20
411 D02	20			80	111 A02	70		10	20
411 D03	20		10	70	111 A03	70		20	10
411 A01	10			90	111 A04	80		20	
411 A02	10			90	111 A05	60		20	10
411 A03	10			90	111 A06	70		10	20
411 A04	10			90	111 A07	70		30	
411 A05	10			90	111 A08	80			20
411 A06	10			90	111 A09	80		10	10
411 A07	10			90	111 A10	80		10	10
411 A08	10			90	111 D02	20		50	30
411 A09	20		10	70	111 D04	20		50	(30% Adherend)
411 A10	10			90	111 D06	20		70	10
421 D01			Adherend Failure		111 D08	20		30	20 (30% Adherend)
421 D04			Adherend Failure		111 D02	60		30	10
421 D05			"		111 D03	60		30	10
421 D06			"		111 D04	70		20	10
421 A11	60			30	111 D05	60		20	20
421 A12	20			50	111 D06	60		20	20
421 A13	70			30	111 D07	50		20	30
421 A14				100	111 D08	70		10	20
					111 D09	80		10	10
					111 D10	40		20	40

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. **TABLE VII**
MODEL
PAGE

FAILURE MODES - JOINED JOINTS									
PHASE I - CONFIGURATION B - DEGRADATION					PHASE I - CONFIGURATION B - BASELINE DATA				
SPECIMEN NO.	TYPE AND PERCENTAGE OF FAILURE AREA	A _B	C	I _B	SPECIMEN NO.	TYPE AND PERCENTAGE OF FAILURE AREA	A _B	C	I _B
11211D01	Adherent Failure				11212A06	Boron Adherent Failure			
11211D02	"				11212A07	"	20	30	
11211D03	"				11212A08	Boron Adherent Failure			
11212A01	"				11212A09	"	30	40	
11212A02	"				11212A10	Boron Adherent Failure			
11212A03	"				PHASE I - CONFIGURATION B - PLY STACKING EFFECTS				
11212A04	"				11211D01	Boron Adherent Failure			
11212A05	"				11212D02	"	"	"	
11212A06	"				11212D03	"	"	"	
11212A07	"				11212A01	10 (10% Boron Adherent)			80
11212A08	"				11212A02	40 (10% Boron Adherent)	20		30
11212A09	"				11212A03	30	10		60
11212A10	"				11212A04	30	10		60
PHASE I - CONFIGURATION B - BASELINE DATA					11212A05	10 (10% Boron Adherent)			80
11211D01	ALUMINUM ADHERENT FAILURE				11212A06	50	20		30
11212D02	"				11212A07	10	20		70
11212D03	"				11212A08	40	20		40
11212A01	"				11212A09	40	20		40
11212A02	"				11212A10	40	20		40
11212A03	"				PHASE I - CONFIGURATION B - LAP JOINTS EFFECTS				
11212A04	"				11211D01	90	10		
11212A05	"				11212D02	BORON ADHERENT FAILURE			
11212A06	"				11212D03	50	50		
11212A07	"				11212A01	10 (30% Adhesive)			60
11212A08	"				11212A02	70	10		20
11212A09	"				11212A03	90			10
11212A10	"				11212A04	80			10
11212D01	BORON ADHERENT FAILURE				11212A05	60			20
11212D02	"				11212A06	70			20
11212D03	"				11212A07	70			80
11212A01	30	30	40		11212A08	50			10
11212A02	20	20	30	30	11212A09	60			10
11212A03	40	20	40		11212A10	70			10
11212A04	30 (10% Adh)	30	30	30					
11212A05	40	30	30						

PHASE I - CONFIGURATION C - BASELINE DATA									
SPECIMEN NO.	TYPE AND PERCENTAGE OF FAILURE AREA	A _B	C	I _B	SPECIMEN NO.	TYPE AND PERCENTAGE OF FAILURE AREA	A _B	C	I _B
11211A01					11211A01				100
11211A02					11211A02				100
11211A03					11211A03				90
11211A04	10				11211A04	10			90
11211A05	10				11211A05	10			90
11211A06	20				11211A06	20			80
11211A07	20				11211A07	20			80
11211A08	20				11211A08	20			80
11211A09					11211A09				100
11211A10	30				11211A10	30			70
11211D01					11211D01				100
11211D02					11211D02				100
11211D03					11211D03				100
PHASE I - CONFIGURATION D - BASELINE DATA									
11211D01					11211D01				90
11211D02					11211D02				80
11211D03					11211D03				80
11211A01					11211A01				90
11211A02					11211A02				100
11211A03					11211A03				100
11211A04	10				11211A04	10			100
11211A05					11211A05				100
11211A06					11211A06				100
11211A07					11211A07				100
11211A08					11211A08				100
11211A09					11211A09				100
11211A10					11211A10				100
11211A11					11211A11				100
11211D01					11211D01				100
11211D02					11211D02				50
11211D03					11211D03				100
11211A01	40				11211A01	40			50
11211A02	40				11211A02	40			60
11211A03	40				11211A03	40			40
11211A04	30				11211A04	30			60

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

REPORT NO. TABLE VI B
MODEL 2
PAGE

FAILURE MODES - BONDED JOINTS

PHASE I - CONFIGURATION D - BASELINE (CONT)					
SPECIMEN NO.	TYPE AND PERCENTAGE OF FAILURE AREA	A _A	A _B	C	I _R I _L
11A1A05	30				40
11A1A06	40				50
11A1A07	30				60
11A1A08	30				50
11A1A09	30				60
11A1A10	40				30
PHASE II - CONFIGURATION A - BASELINE DATA					
11A1D01	(50% Adherend)				50
11D02	ADHEREND FAILURE				
11D03	(80% Adherend)				20
11D04	ADHEREND FAILURE				
11D05	"				
11D06	"				
11A01					90
11A02					90
11A03					90
21A03	(10% Adherend)				90
11A05	(50% Adherend)				50
11A06	(10% Adherend)				90
11A07					90
21A04	10				80
11A09					100
11A10					100
11A1C01					20
11C02					10
11C03					20
11C04					30
11C05					100
11A12D01					80
12D02	10				90
12D03					70
12A01					30
12A02					10
12A03					10
12A04					10
12A05					10

PHASE II - CONFIGURATION A - BASELINE (CONT)					
SPECIMEN NO.	TYPE AND PERCENTAGE OF FAILURE AREA	A _A	A _B	C	I _B I _L
11A12A04					100
12A05					90
PHASE II - CONFIGURATION A - DEGRADATION					
11A12A01	(30% Adherend)				60
21A02	(30% Adherend)				70
21A05					90
11A04	(30% Adherend)				70
11A08	10				90
21A01	(20% Adherend)				40
21A02					90
21A03	10				90
21A04					90
21A05					80
PHASE II - CONFIGURATION A - REALISTIC SPECTRUM					
11A1001	10				90
11002					80
11003					90
11004	10				90
11005	10				90
PHASE II - CONFIGURATION A - LAP LENGTH EFFECTS					
11A91D01	(30% Adherend)				10
91D02	(30% Adherend)				10
91D03	ADHEREND FAILURE				
91D04	"				
91D05	"				
91D06	"				
91A01	NO FAILURE				
91A02					100
91A03					100
91A04	20				70
91A05	20				60
91C01					60
91C02	10				30
91C03	20				20
91C04	40				10

PHASE II - CONFIGURATION A - LAP LENGTH (CONT)					
SPECIMEN NO.	TYPE AND PERCENTAGE OF FAILURE AREA	A _A	A _B	C	I _B I _L
11A91C05	20				20
PHASE II - CONFIGURATION B - BASELINE DATA					
11B1D01	BORON ADHEREND FAILURE				
11D03	"				
11A01	"				
11A02	60				40
11A03	40				20
11A04					
11A05	10				40
11D02	(20% Adherend)				50
11D04	TITANIUM ADHEREND BUCKLED				
11C01	BORON ADHEREND FAILURE				
11C02	20				70
11C03	10				60
11C04	10				90
11C05	20				70
11C06	20				80
11B1D01	ALUMINUM ADHEREND FAILURE				
12D02	"				
12D03	"				
12A01	"				
12A02	"				
12A03	"				
12A04	"				
12A05	"				
PHASE II - CONFIGURATION B - LAP LENGTH EFFECTS					
11B31D01	BORON ADHEREND FAILURE				
31D02	"				
31D03	"				
31A01	30				60
31A02	90				10
31A03	80				10
31A04	30				60
31A05	(30% Adherend)				40

FAILURE MODES - BONDED JOINTS

PHASE III - CONFIGURATION A - ALL TESTS										PHASE III - CONFIGURATION B - ALL TESTS									
SPECIMEN		TYPE AND PERCENTAGE OF FAILURE AREA								SPECIMEN		TYPE AND PERCENTAGE OF FAILURE AREA							
NO.		AM	AB	C	I _a	I _b	I _c	I _d		NO.		AM	AB	C	I _a	I _b	I _c	I _d	
111A11D1				NO FAILURE						111B11D1				ADHEREND FAILURE					
11D8								100		11B2				"					
11D3				ADHEREND FAILURE						11B3				"					
11D4				ADHEREND FAILURE						11A1		60		30	10				
11D5				"						11B1				NO FAILURE					
11D6				100						21P1		30		50	20				
11A1				(10% Adherend)	90														
11B1				(20% Unfailed)	30	50													
11C1				10	90														
111A21P1		30	30			40													
111A12D1				30	50	20													
12D2				30	70														
12D3				30	70														
12D4				50	50														
12A1		10	60			30													
12B1				40	10														

APPENDIX C

JOINT DESIGNS

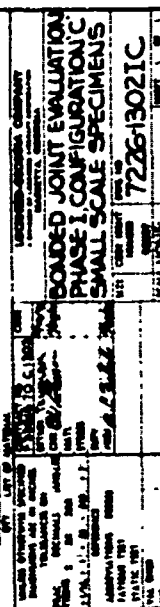
This section contains the detail design drawings for test specimen configurations under the evaluation program. Given below is a complete list of drawings and their usage.

<u>Phase</u>	<u>Configuration</u>	<u>Status</u>
I	A, B, C, & D	Included
II	A & B	Provided as notes to Phase IA & B drawings
III	A & B	Provided as notes to Phase IA & B drawings
I	E & F	Included
II	E	Provided as notes to Phase IE drawings

[illegible]

FORM 100-10	1.520	1020	3020	47	50
1	1.520	1020	3020	47	50
2	1.520	1020	3020	47	50
3	1.520	1020	3020	47	50
4	1.520	1020	3020	47	50
5	1.520	1020	3020	47	50
6	1.520	1020	3020	47	50
7	1.520	1020	3020	47	50
8	1.520	1020	3020	47	50
9	1.520	1020	3020	47	50
10	1.520	1020	3020	47	50
11	1.520	1020	3020	47	50
12	1.520	1020	3020	47	50
13	1.520	1020	3020	47	50
14	1.520	1020	3020	47	50
15	1.520	1020	3020	47	50
16	1.520	1020	3020	47	50
17	1.520	1020	3020	47	50
18	1.520	1020	3020	47	50
19	1.520	1020	3020	47	50
20	1.520	1020	3020	47	50
21	1.520	1020	3020	47	50
22	1.520	1020	3020	47	50
23	1.520	1020	3020	47	50
24	1.520	1020	3020	47	50
25	1.520	1020	3020	47	50
26	1.520	1020	3020	47	50
27	1.520	1020	3020	47	50
28	1.520	1020	3020	47	50
29	1.520	1020	3020	47	50
30	1.520	1020	3020	47	50
31	1.520	1020	3020	47	50
32	1.520	1020	3020	47	50
33	1.520	1020	3020	47	50
34	1.520	1020	3020	47	50
35	1.520	1020	3020	47	50
36	1.520	1020	3020	47	50
37	1.520	1020	3020	47	50
38	1.520	1020	3020	47	50
39	1.520	1020	3020	47	50
40	1.520	1020	3020	47	50
41	1.520	1020	3020	47	50
42	1.520	1020	3020	47	50
43	1.520	1020	3020	47	50
44	1.520	1020	3020	47	50
45	1.520	1020	3020	47	50
46	1.520	1020	3020	47	50
47	1.520	1020	3020	47	50
48	1.520	1020	3020	47	50
49	1.520	1020	3020	47	50
50	1.520	1020	3020	47	50
51	1.520	1020	3020	47	50
52	1.520	1020	3020	47	50
53	1.520	1020	3020	47	50
54	1.520	1020	3020	47	50
55	1.520	1020	3020	47	50
56	1.520	1020	3020	47	50
57	1.520	1020	3020	47	50
58	1.520	1020	3020	47	50
59	1.520	1020	3020	47	50
60	1.520	1020	3020	47	50
61	1.520	1020	3020	47	50
62	1.520	1020	3020	47	50
63	1.520	1020	3020	47	50
64	1.520	1020	3020	47	50
65	1.520	1020	3020	47	50

▲▲ FAB PER STEP 31:304
 NO FABRICATE 13 - 18 SPECIMEN ASSAYS AND 13 - 18 SPECIMEN ASSAYS WITH EXCEPTIONS: BOND - 29 SPEC AND - 31 SPEC USING METAL BOND 329
 ADHESIVE - CURE AT 250°F. FOR ONE HOUR AT 15 PSI TO 30 PSI
 WITH HEATING RATE THIRTY MINUTES TO TWO HOURS. - IDENTIFY AS
 - 18X SPECIMEN ASSAY AND - 18X SPECIMEN ASSAY RESPECTIVELY
 ▲ BOND USING STM 30-102 TYPE III, 050 PSI - BOND LINE TOLERANCE ±.0015
 ▲ BOND SURFACES SHALL BE FLAT AND PARALLEL WITHIN .002
 ▲ BOND USING STM 30-102 TYPE III, 045 PSI
 ▲ NARMCO 5505 BORON FILAMENT
 ▲ REMOVED
 ▲ FAB PER DS 20004
 ▲ CLOSE TOL RANCE PER DS 30009 --- FAB PER STEP 51:304
 ▲ REMOVED
 ▲ FAB PER STEP 60:202
 NOTE:



- ▲ M 19 P96 PM 6 M187-6 COLLAR
- ▲ M 18 P96 PM 6 M187-6 COLLAR
- ▲ 11- GAL -1V-1M DA STM07-306 1AB PER STEP 21-304
- ▲ TORQUE TO 30 IN LBS
- ▲ FOR PHU BEARING TEST USE STAN-CORPOLEN (M1-10K) OR EQUIVALENT MANUFACTURED PHU HAVING 1000 DIA SHAANK
- 1 M11 INSTALL FASTENERS PER STEP 56-105
- ▲ CUTTER SURFACES SHALL BE FLAT AND PARALLEL WITHIN .002
- ▲ BOLD USING STM 30-102 TYPE III OAS P5F
- ▲ NORMED 5405 BORON FILAMENT
- 3 USUAL FASTENERS PER D5 5055
- ▲ M45 PER D5 30004
- 3 Y80 - STREACHED + ST3AG007
- ▲ SHAW - 012 11- GAL-4V ARMALRED STM07-306
- ▲ M45 PER STEP 51-508
- ▲ M45 PER STEP 60-202

NOTE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
										TEMP-10022A-15 (OLD TAB)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															

[illegible]

